KEEP YOUR APPLE RUNNING

The Common Person's Repair Guide

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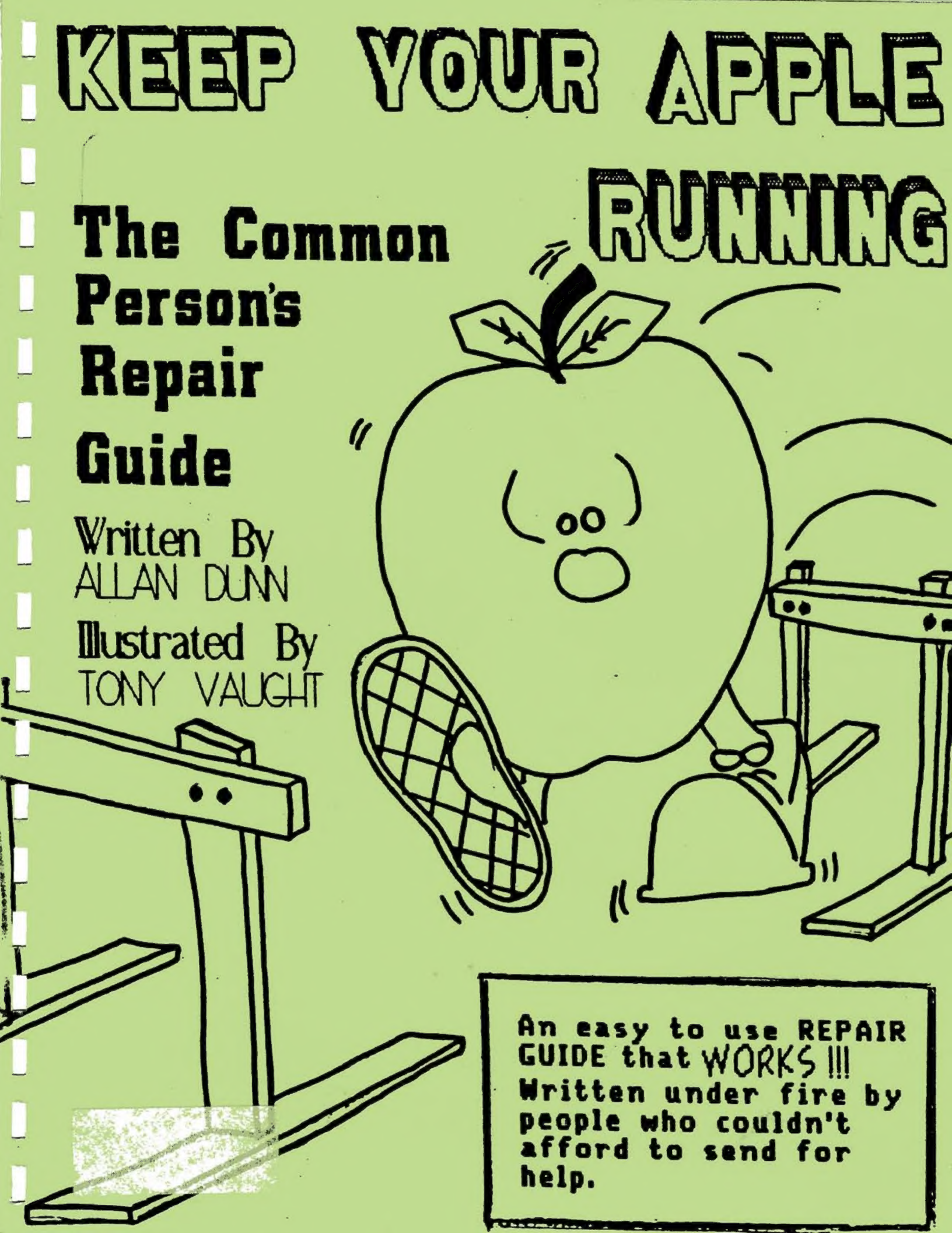

An easy to use REPAIR GUIDE that WORKS !!!
Written under fire by people who couldn't afford to send for help.

W A R N I N G ! !

The author and illustrator are taking great pains at this point to caution the reader that the information in this book is based on our experience. We feel it can be a valuable guide for the Apple owner and user. WE CAN NOT, HOWEVER, TAKE RESPONSIBILITY FOR ANY DAMAGE OR INJURY CAUSED AS A RESULT OF USING THIS BOOK. We can say it has worked for us and we are willing to share the knowledge. We are also very willing to receive input for future revisions.

If your computer system is under warranty do not do any procedures which would void your protection. Make use of your dealer for warranty repairs.

W A R N I N G

C O M P L E T E D ! !

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MAKE A FORTUNE!!!

Yes, we could make a fortune if every Apple owner opened their cores and bought our book. We amazingly completed it before the Apple II was discontinued and is now ready for your eager eyes. If you swiped this copy off a friend or founded it mutilated and covered with refuse in a garbage can we have a ingenious way for you to get your own copy! Just send us money and we will send you a copy which is guaranteed to have a few light-hearted blunders just like this one.

Send **$11.95** to:

CONSIDER IT DUNN
P. O. BOX 5362
OREGON CITY, OR 97045

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ACKNOWLEDGMENTS

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WORKSHOPS

For information concerning workshops on computer maintenance and repair please contact us at (503) 656-3818 or write to our address.

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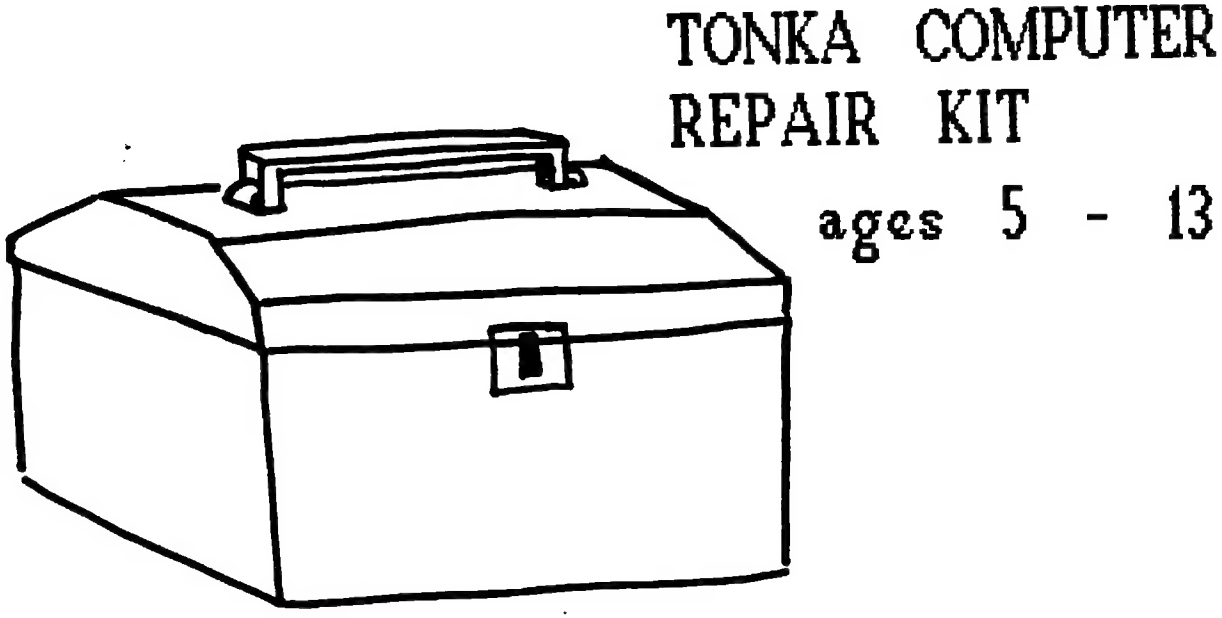
Chapter I: INTRODUCTION

You are an up-and-coming star in the business world and are an avid user of your computer. In fact, your latest innovation which is to be presented to the boss in two days is safely stored on disk. You go to the computer and turn it on. It beeps, lights flicker, and then nothing! No problem, though, you have two days! You pack up the system and deliver it to your local computer store. In the process, the disk drive slips off the computer and crashes (literally) on the floor.

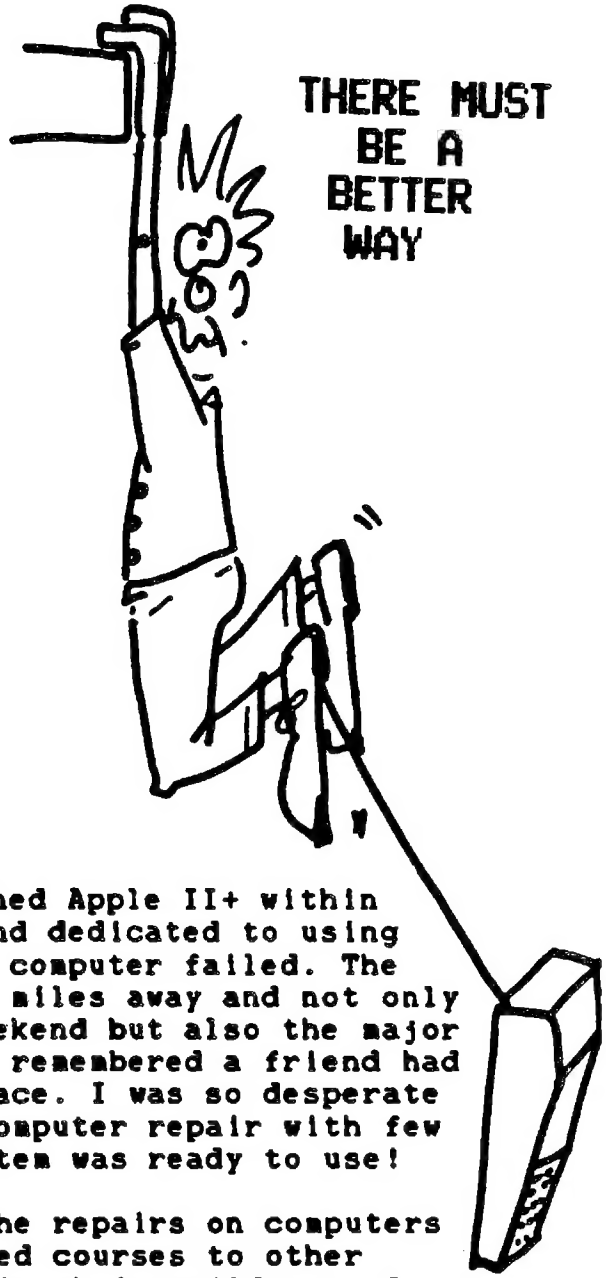
The computer store repair center. The shelves are lined with computers, printers, and disk drives below the "IN" sign. One small shelf below the "OUT" sign is bare except for someone's three day old sandwich that rotted itself to the dust covered shelf.

The repair manager glances up as you plop down your load. He "glances up" because he is not a very tall ten year old. The paperwork is done and you have explained the urgency of the situation. The adult psychologist says, "not to worry, I'll call you when it is ready." Your confidence is not at an all time high.



The next day comes and goes without a word from miracle boy. You call late in the day but the repair manager is "in training" and won't be in today. You never used to chew on your finger nails let alone your fingers! The next morning you get a call from the kid at the computer store. Your system is ready! After paying your bill you rush to the office and set up your system.

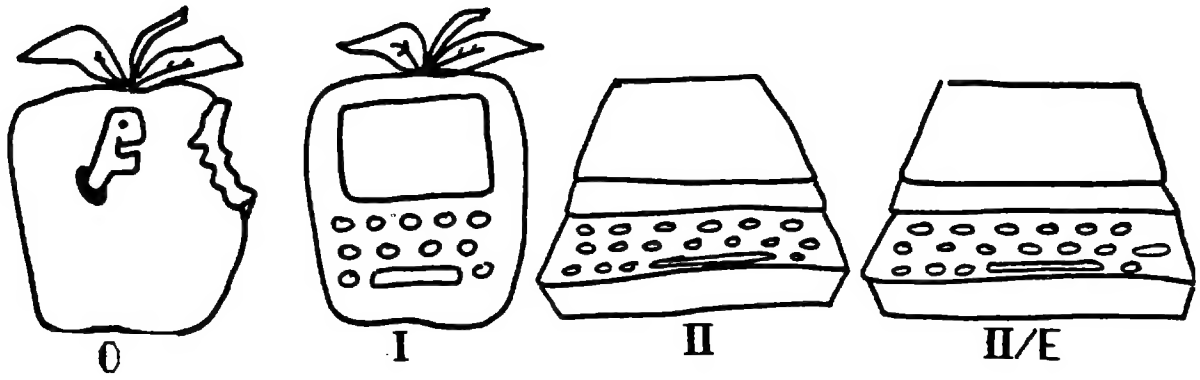
You have two hours before your conference with the Big One. You turn on the computer and notice smoke slowly rising from the disk drive. As the smell of burning plastic engulfs your head, a driving madness grips your brain. You grab all the pieces of your computer system and with a Tarzan-like yell heave it through your tenth story office window. Not only does madness grip you but so does the monitor and printer cord. While dangling from your window with your computer system tied to your foot like a dead albatross you calmly reflect, "There has got to be an easier way to fix computers."



In 1980, I had the only school-owned Apple II+ within twenty miles. On a Friday of a weekend dedicated to using the computer the power switch on the computer failed. The nearest computer repair store was 40 miles away and not only would I lose the computer for the weekend but also the major part of the next school week. Then I remembered a friend had said that the switch is easy to replace. I was so desperate that I took this first plunge into computer repair with few regrets. In an hour the computer system was ready to use!

Since then, I have done most of the repairs on computers in my school district and have offered courses to other teachers on how to maintain systems in their buildings. I also went through the three day Apple Computer Level I Training program and have taken one quarter of electronics at a community college. The training and formal education was helpful but the practical experience in repair and using my own problem solving skills were by far more valuable. The essence of this book is to give you those skills.

Since the late 70's, Apple has made at least four major design changes in their Apple II family of computers. The material in this book is specifically written for the Apple IIe computer because that seems to be the predominate breed at this time. Remember, though, that the disk drive and controller card used on the II, II+, and the IIe have changed little in the last six years. Also, the system configuration for all the Apple IIs has changed little. For those reasons, most of the procedures should apply to all of the Apple II systems. Finally, the problem solving approach presented would be relevant to just about any computer system.



Why do you want to even consider maintaining and repairing your computer or the computers in your building or work area? During the last two years of teaching maintenance of computers to teachers and students I have discovered that the benefits from such "practical" information go far beyond the direct goal of keeping a computer system in action.

1. Destroy the "magic box syndrome". A little background as to how the computer works, what it looks like on the inside, and how the parts fit together provides the user a solid foundation in understanding this tech tool. Rattling sounds in the disk drive will take on a new importance for the user rather than produce breath-grabbing fear that a disk has been eaten. This background will also make it easier to help others understand how the computer works. "Myths" about computers will come under more objective criticism.

2. When a computer malfunctioned I use to drag everything to the repair center- monitor, disk drive, computer and printer. One of the goals of this book is to isolate the problem to a module so that only that module needs to be sent in for repair. For example, a bad printer can lock up a computer. If the problem is correctly

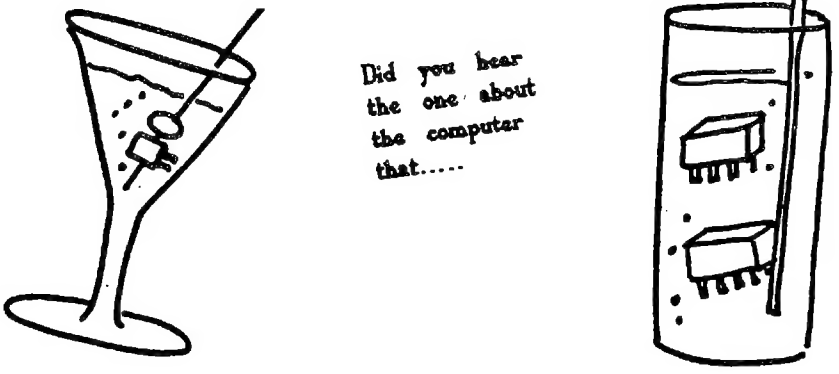
diagnosed, only the printer takes a trip to the repair professionals, leaving you with a working computer!

3. If you need to take your system to a technician you will be able to describe the problem and, in many cases, suggest a solution which will hasten the repair. It is, of course, your responsibility to humble yourself with your local tech person. Be advised not to say, "Could you replace the LS125 chip on the disk drive analog card?" Rather, try, "Gee, the disk spinner just spins and it smells like burning plastic. Do you have a fire extinguisher here just in case??"

4. Time will be saved! Problems which can be fixed on-site will be and only the most serious cases will need to be taken to the doctor. According to recent statistics which I just made up eighty percent of the malfunctions of an Apple IIe computer can be taken care of by you. (For the older models I would guess the percent is closer to 90.)

5. Computer repair can be expensive. Parts, labor, travel, and down time can add up to quite a bill. Handling minor problems yourself would cut the cost of owning a IIe to a very small amount.

6. Computer repair talk can liven up an otherwise dull party. A favorite repair trick or a horror story about a computer that was run over by a semi-truck and lived will generate cries of delight from other guests.



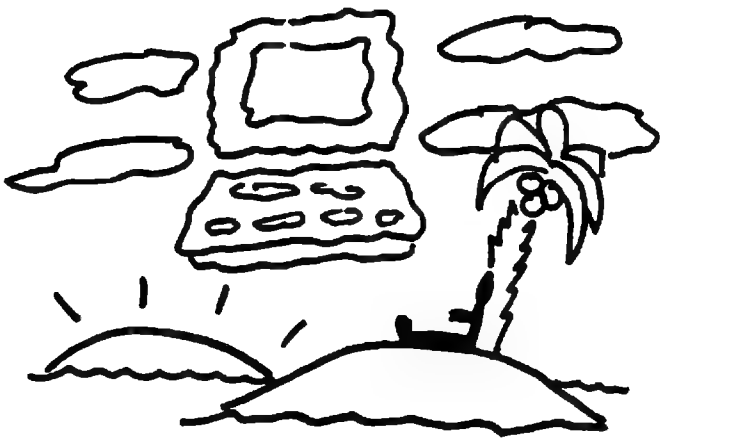
This is not a typical repair manual so it is important that dangers are spelled out for the reader. First, if a computer is under warranty do not try complicated solutions or experiments outlined in this book. Stick to the directions given in your Apple IIe manual on set up and trouble shooting. Return the computer to the store for problems beyond the scope of the manual and let them handle the problem.

Part of this book describes how to make your system malfunction so that you will recognize problems and be able to solve them. Take care in following instructions for these exercises and, if possible, work with someone so that you can check each other. Do only one exercise at a time and be sure you remember what you did to create the problem!

Double check connections and directions when assembling a computer system and before turning on the power. Be sure chips are properly oriented (pointed in the right direction) and cable connections are correctly attached (number 1 pin is in number 1 hole!).

One goal of this book is to make you aware of your computer and feel more comfortable about handling it. So, do only those activities which fit into your comfort level and save the others for when someone else can be available to help. If chip swapping makes you nervous, then skip that chapter!

The material in this book is designed for those that have had some experience with the Apple computer. Programming is not required, nor is a masters degree in electronic engineering. What is required is a working knowledge of the computer, such as how to load a disk, catalog, and break out of a program. And, more important, you need an inquisitive, courageous, problem solving mental attitude.



Think of yourself as a modern day Robinson Crusoe lost on Chip Island with only your bare hands to tackle all those nasty computer problems that keep you from enjoying paradise. Paradise is just pages away!

In addition to what is offered in this book, you need to search out other resources. First, make contact with other daring Apple II owners who would like to repair their own equipment. In fact, many of the exercises in the book require a good system for checking bad components. Work together on exercises and test each other to discover what was bugged on the system.

A number of computer magazines are printing articles concerning computer maintenance and repair. "A+", "Creative Computing", "The Computing Teacher", and "Call A.P.P.L.E." are a few of the journals that offer specific ideas to help work with the misbehaving computer.

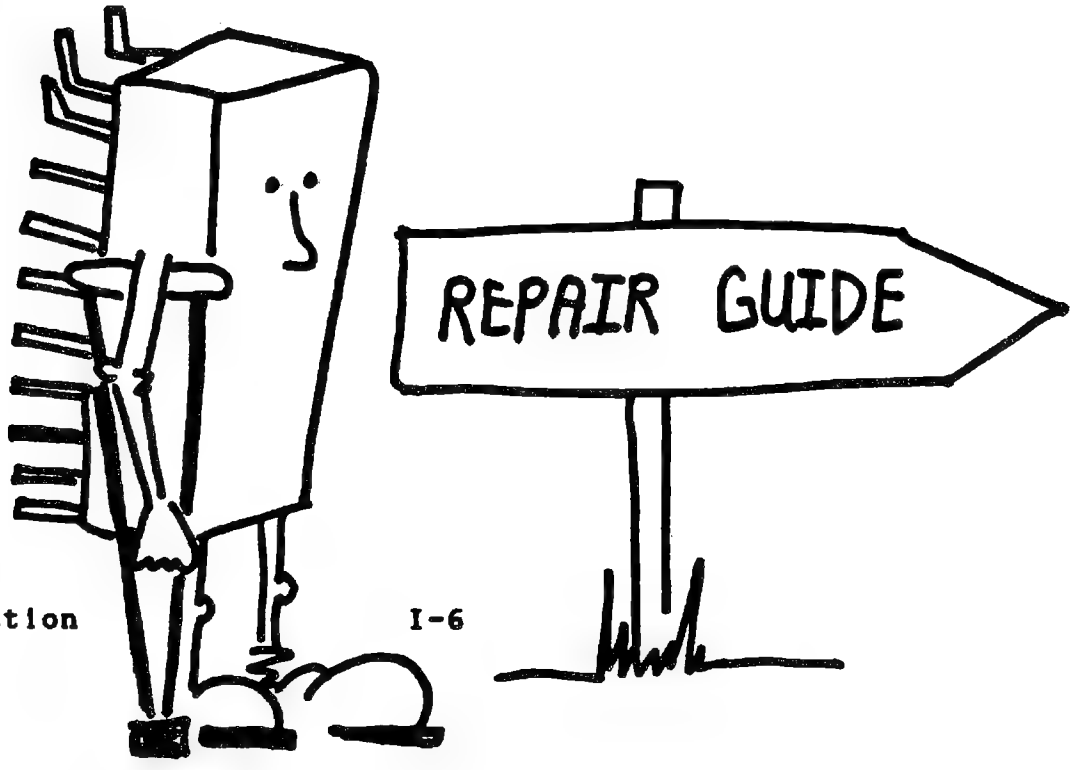
Do not burn your bridges! Your Apple dealer is still one of your best sources for assistance and service. Work with the technician at the store. The more information you can provide in a repair problem the quicker the system will be fixed. Most shops are stocked with parts which can be quickly exchanged so that you can be on your way. Also note that some parts are available only through your Apple dealer!

Many of the parts in the Apple II and IIe systems are available at electronics supply houses. Not hi-fi supermarkets, but rather those stores where serious hobbyists go to find their supplies. Check in the yellow pages under "Electronic Equipment and Supplies" for stores in your area. Two stores in the Portland area I have used are:

NORVAC Electronics
12905 SW Beaverdam
Beaverton, Oregon
(503) 644-1025

Radar Electric Company Inc.
704 SE Washington
Portland, Oregon
(503) 232-3404

This book can be used in a number of ways, depending on your experience and goals. It can be used as a resource on information about the Apple II family of computers. For those who want to repair, it offers exercises on how to bug systems for practical experience in diagnosing problems. If you have a faulty system it will provide you with step by step methods in diagnostics. So, depending on your needs, either tear into your computer, the book, or both!

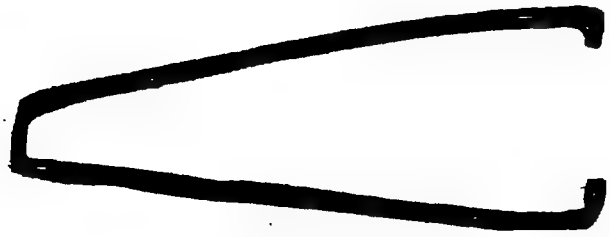


Chapter II: Tools

Getting set up in the computer repair and maintenance business is very inexpensive. In many cases no tools are needed to make minor repairs. Here, though, are some suggested tools for handling most situations.

Required - kind of...

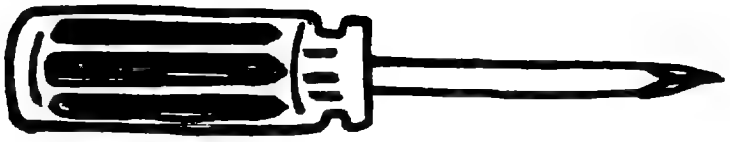
1. Chip puller or IC extractor. These look like tweezers but with small 90 degree bends at the tips for grabbing chips. They can also be used for removing paddle and joystick connectors as well as disk drive and printer cables. If you were the proud owner of an Apple II Plus computer which was upgraded to 64K of memory with a Microsoft RAM card you may already have one. A chip puller was supplied with the card.



IC Extractor

IC extractors can be purchased at electronics stores. They are usually packaged with a device for inserting chips. It makes it much easier to charge more for a piece of bent metal! The package price for both tools is around $5 to $8 and the chip extractor by itself ranges from $1 to $3.

2. Phillips screw driver. Most of the fasteners on the Apple computer are Phillips screws. Purchase a good quality screw driver to match these screws.



Phillips Screw Driver

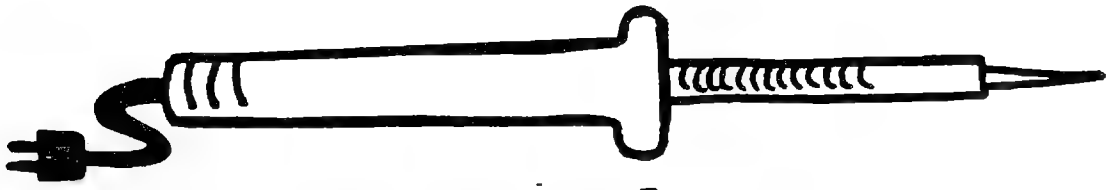
3. Bit Copier Program. Yes, get one! They have other functions besides making "backup" copies of software. For our purposes, most have a disk drive speed check to adjust disk drives motors so they run at the right speed. Also, some malfunctioning disk drives wipe out the Disk Operating System (DOS) on the disk. Using the copy program, this DOS can be recopied onto your damaged disk to bring it back to life. More uses will become apparent as you work through the book. (See chapter 8 for more information.) Some bit copy programs are:

Copy II+
Central Point Software
P. O. Box 19730-203
Portland, Oregon 97219
(503) 244-5782

Nibbles Away
Computer: Applications, Inc.
12813 Lindley Drive
Raleigh, N. Carolina 27614

Optional tools:

4. Soldering iron and accessories. The accessories include solder (rosin core) and something to suck up the melted solder. Use the iron to fix the monitor connection on the main board, replace bad key switches and power switches, and to fix those paddles! Cost varies, but are usually under $20.



Soldering Iron

5. Thin, standard head screw driver. I usually use my finger nail to adjust the screw for the drive speed. A small screw driver might be a good investment if you chew your nails. It is also handy for wedging out big IC chips. An eight inch long screwdriver with an eighth inch head would do fine.

Regular Screw Driver

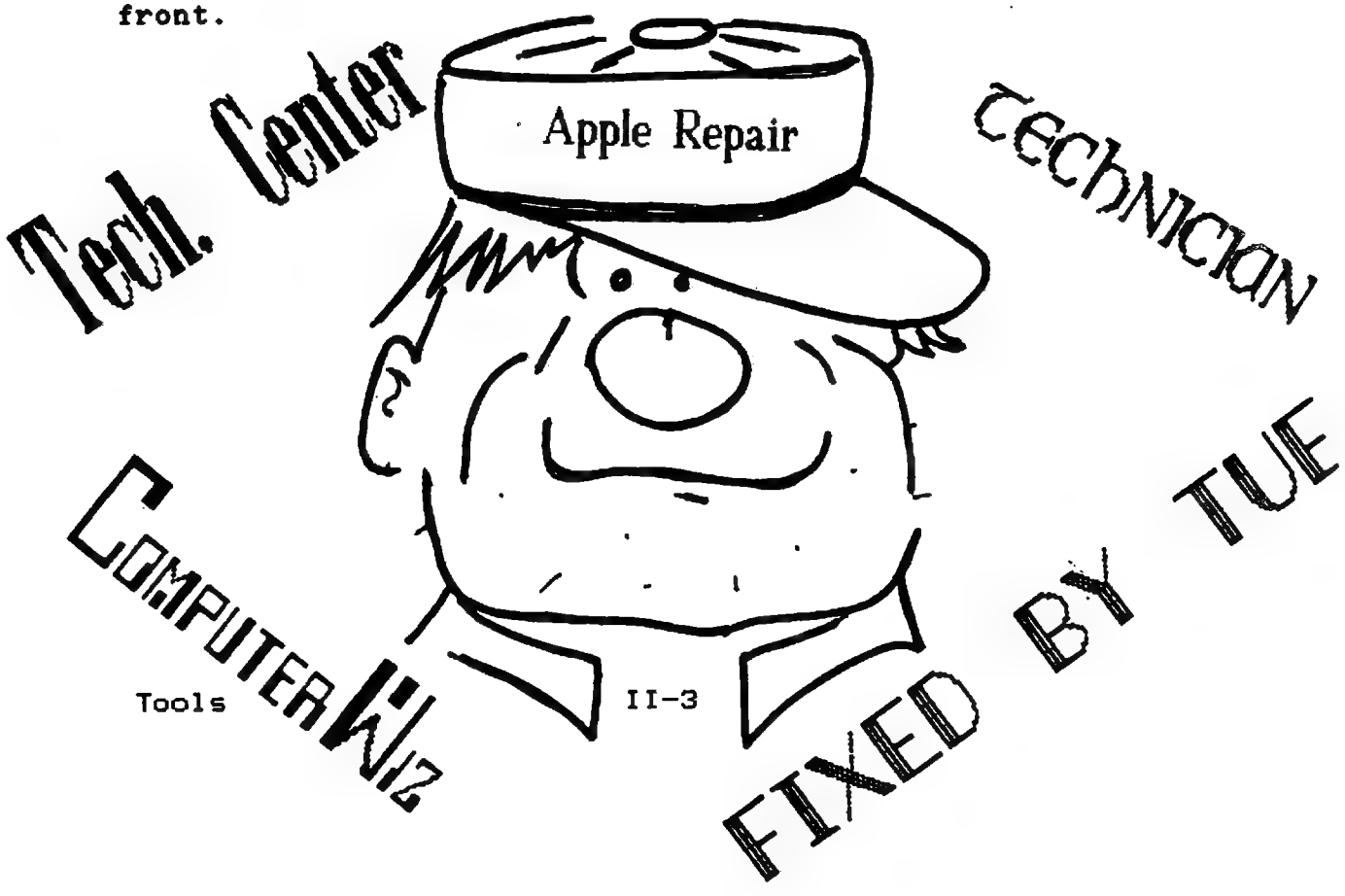
6. Sharp knife. Use the knife for stripping wire, pealing real apples, and fighting off irate friends who trusted you to fix their computers.

7. Spare parts. If you are sheltering 5 or more computers and it is a long drive to your parts source, it is very useful to have extra parts on hand. A list of chips is provided in Chapter IX.

8. Cleaner and rags. Again, if you are servicing a number of computers it never hurts your reputation to give the casing a good cleaning. Cleaning seems to give the users (especially in schools) inspiration to work with the "new" computer. Be careful not to get the cleaner on the computer parts. I usually spray a rag and then use the rag on the computer casing. A more thorough job can be done by removing all the parts from the casing and then spray the cover and let the cleaner work on the grease and dirt.

9. Tape head cleaner and swabs. The swabs can be 6-8 inch cotton swabs, but electronics stores sell foam covered swabs. Cotton tends to leave some fibers to gum up the works while the foam ones don't. These are used to clean the head of the disk drive and the guide rails on the disk drive. (See chapter VII.)

10. Sign, shirt, or hat with title. It is imperative to let strangers know what your role in life is! Get an old tool box and paste a sign on the side saying "COMPUTER TECHNICIAN". Be sure to have wires dangling from the box. Hats should be worn with a slight tilt to the side with "Apple Tech. Center" emblazoned on the front.



Chapter III: Exposing the Apple IIE

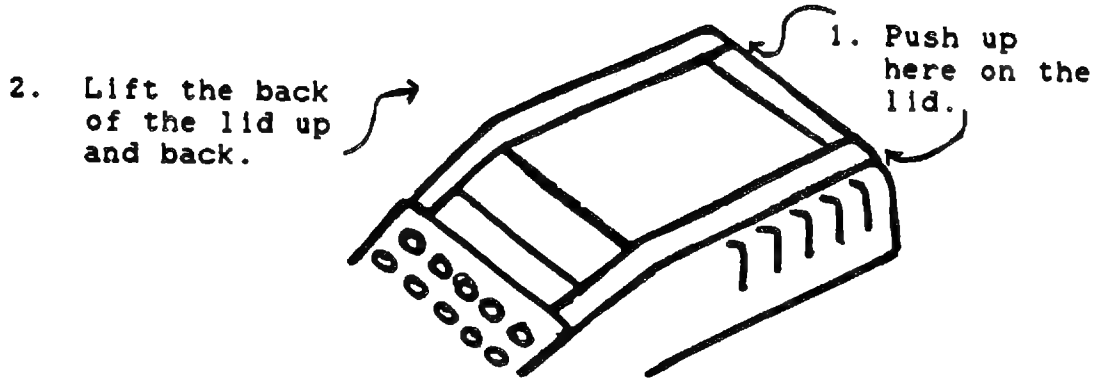
In my first year of teaching at a large school I was given an advanced computer science class. Honesty requires me to say that those students were as knowledgeable about computers as I was so, I tended to be beyond shock when they revealed a new part of their expertise. But one day they nearly accomplished that feat.

As I walked into the lab I noticed a bunch of my students surrounding a computer and emitting sounds of wonderment. I sauntered over toward them and saw that the text on the screen was printed upside down! Not only that, but when the star student listed the program it scrolled off the bottom of the screen. I had seen similar stuff done with graphics but never was the display so quick.

Just as I was about to congratulate the smiling student I noticed that the control knobs for the monitor he was using were above the screen instead of below and the on-off switch was on the left side rather than the right!

It is time to get comfortable with the computer. For those that may have set up their own computer, this will be a familiar visit but with some new tricks. Read the tips given here on working with a computer system and then proceed to the steps that follow. Before starting, though, let's make sure the computer is working! Use an initialized disk of low personal value and start the computer. Never use a prized disk (your word processor disk!) when working on computers, especially ones that are malfunctioning. They can destroy your disk.

If all goes well, take the top off the computer so that parts described below are clearly visible. To do this, remove all items on top of the computer (monitor, disk drive, cat?) and lift up on the back of the computer lid at each side. The lid should pop loose from its Velcro-type bond and you can remove it by sliding it away from you about an inch and then lifting it off. If it refuses to come, examine the back for two screws that might be holding the lid down.



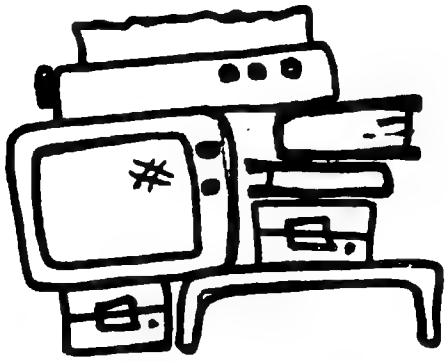
Removing the top

Before attacking your computer take time to read the following section on handling computer equipment.

Tips for working with computer hardware:

1. Be sure the power is off! Yes, it is important not to yank cards out of the computer with the power on. Important for the life of your computer and your pocketbook. There is little danger to you physically unless it was someone else's computer you were working on at the time. In most cases no serious damage will happen even with the power on -I have accidentally done it many times- but the potential is definitely there. If you don't trust yourself, get in the habit of unplugging the power cord from the back of the Apple before opening the lid. Also, look for the power light on the keyboard and the red LED light on the main board next to the power supply box. If either is on STOP!

2. Give yourself room to work. Space is needed to lay out cables, monitors, disk drives, and internal parts. Without proper space printers end up balanced on the monitor which is PRECARIOUSLY perched on two stacked drives. A small wind would topple the stack of technology.



3. Treat interface cards carefully. The cards that fit in the slots in the computer have short wire stems on the soldered side as well as resisters, condensers, and feely gickies. If wire stems are bent or other parts are broken, then serious problems crop up. Use a cloth (sweater, towel, etc.) or some foam to store these cards.

4. Ground yourself. Those black rectangles called chips (integrated circuits or ICs for short) embedded in the cards and the main computer board can be damaged by static electricity. The circuits inside these chips are extremely small and can be destroyed by surges of power. The best way to ground yourself is to touch the power box inside the Apple. Avoid situations where static electricity tends to be produced, such as on carpets or plastic chairs. If there seems to be a lot of static then just keep a hand on the power supply.

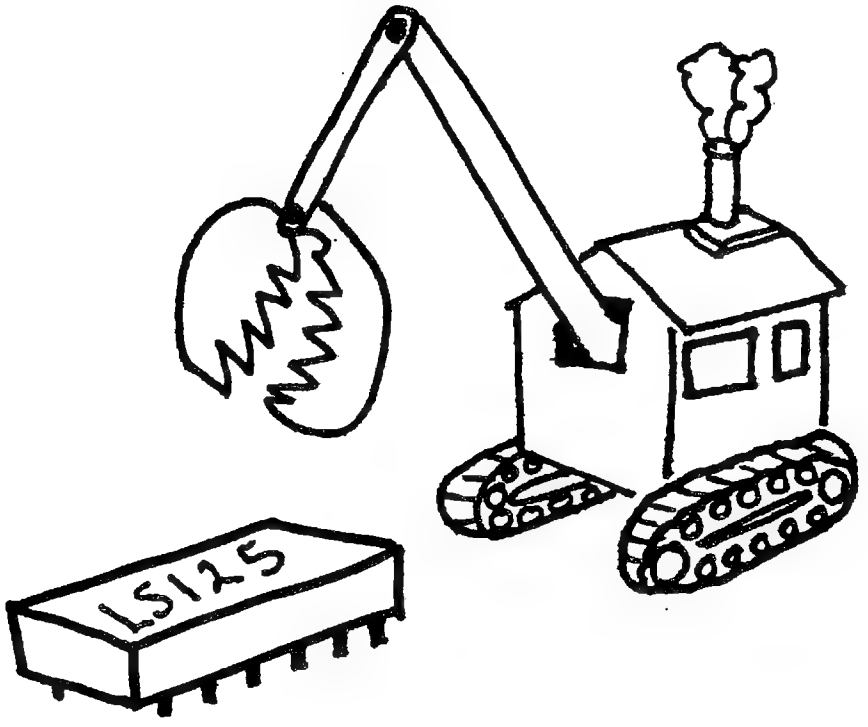
How serious is this concern? I have had computers reboot when I touched the casing and there was a static discharge. I never have damaged equipment with static

electricity. The concerns I have heard seem to be based more on fear than fact and have kept people separated from their tool.

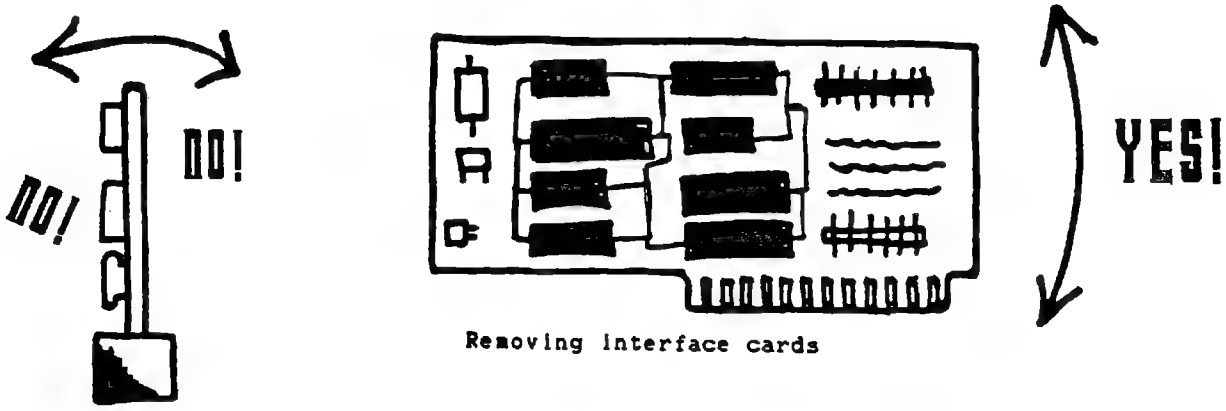
5. Have manuals at hand. Yes, I mean those wonderful books that came with your computer and are stored somewhere in the attic. The best guide for working with your computer are those installation directions that came with your bundle of joy.

6. Note where each part is located. Observe from what slot or socket parts are removed. There are seven slots in the back numbered from 1 to 7 and one in the center left of the computer labeled the "Auxiliary slot". Remember the orientation of the parts to their sockets. Which part of the card faced forward? Do the cable wires face toward the back or front? Careful attention at this stage and even some written notes can save some time when parts are put back in the system.

7. Check stubborn parts. Before hiring a crane to remove a stubborn card or connector, check for obstructions, screws, tape, welds, or other fasteners which might be causing the problem. I have broken a few parts because I forced a part which was actually a part of a part. Not smart!

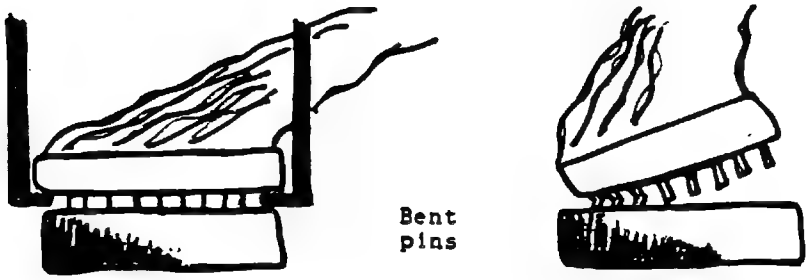


8. Remove cards in slots with a forward/back motion. The boards in the Apple computer are tough and somewhat flexible. They can take a lot of pulling and pushing. When removing them from the slots, be sure to pull or push from front or back. Side motion could crack the slot, though this would take a great deal of effort. Most of the cards can be grasped by one of the upper corners and pulled from its socket.



Removing interface cards

9. Remove paddles and cables with chip pullers. Of course, chip pullers aren't always available. In those cases resort to a gentle hand and try to pull the connector straight up rather than to the side. Side motion can bend or break of some of the pins.



Pull straight up (CORRECT)

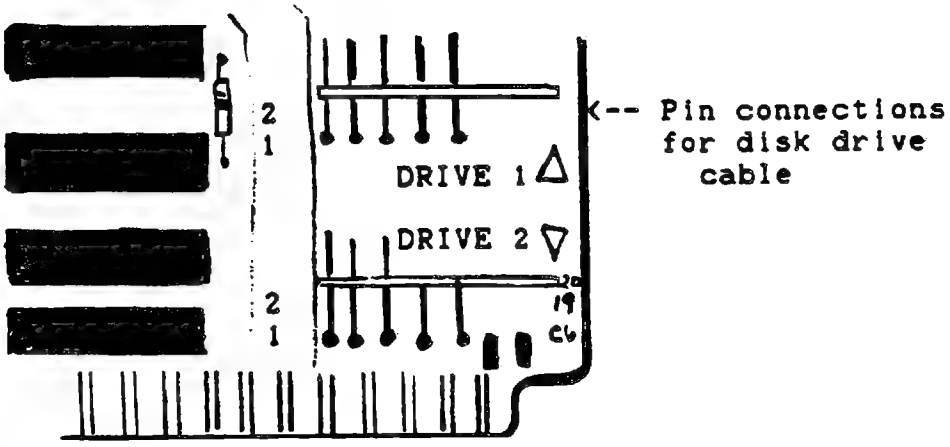
Pulling unevenly (NOT GOOD!!)

10. Pull on the connector. Those cables are convenient to grab onto for removing connectors, but they occasionally break from repeated stress. Grab the connector with the chip puller if possible or use your fingers. In some hard to get at locations, use the knife edge to work the connector out of its socket.

11. Check orientation of connectors. When the Apple computer came into existence, its makers issued a stern commandment:

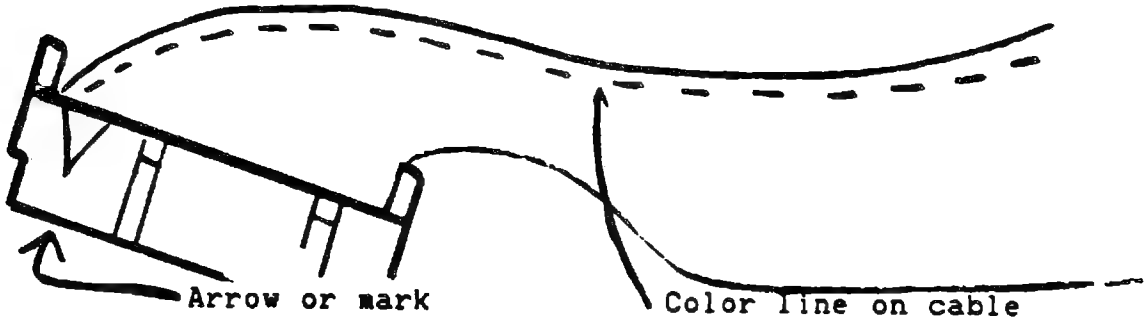
> *Let there be one confusing connection on the Apple guaranteed to damage equipment and bring everlasting life to repair centers.*

That one connection was the disk drive cable connected to the disk interface card. Examine the card:



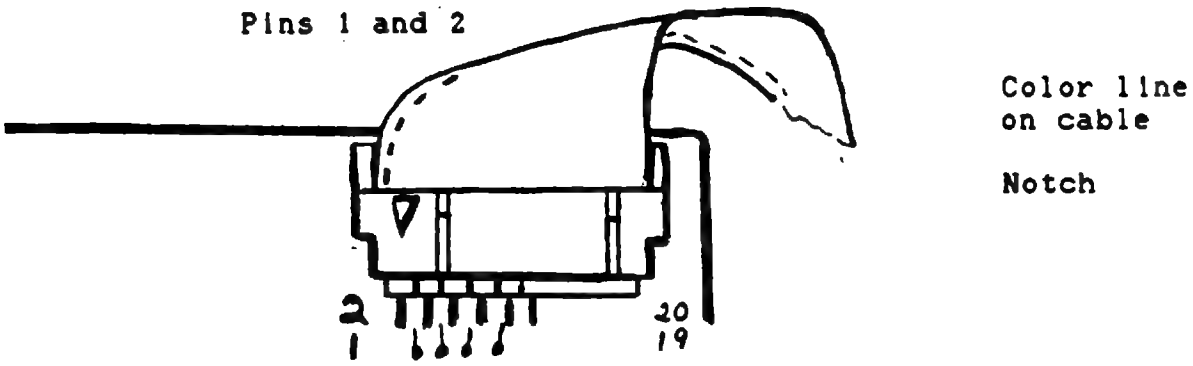
Notice that to the left of the pins for drives 1 and 2 there are two little numbers- 1 and 2 painted on the green board. This indicates where the number one and two pin from the disk drive are to go.

Now look at the disk drive cable and connector:



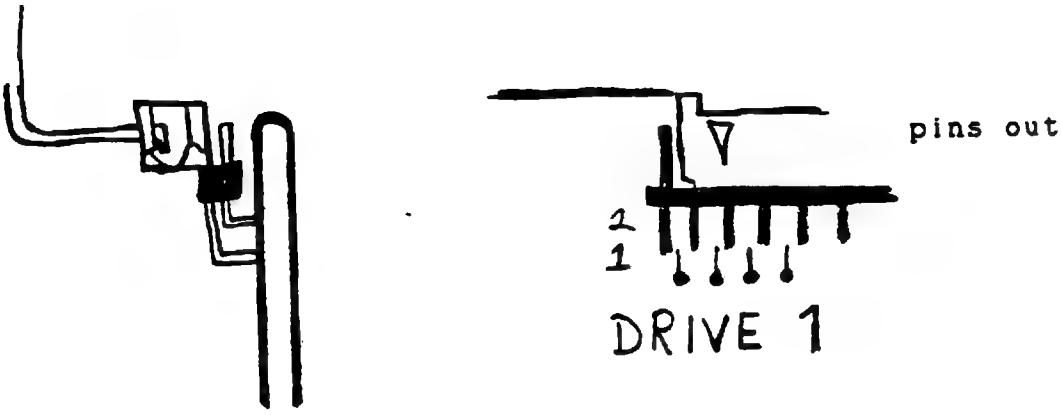
Some connectors have a small arrow, others have just a small groove which is just under the cable. This groove or arrow indicates that sockets for the one and two pins are on that side of the cable and should be lined up with the one and two pins on the disk drive card. Most cables also come with a red line on one side that serves the same purpose: pins one and two are on that side.

The whole idea of connecting cables to pins is to keep the orientation of the pins correct-- number 1 pin goes to number 1 socket. The connection should go like this:



Aligning cable connector and socket

DANGER! Now with this information at least the cable should be oriented properly. That's half of the battle! But now be sure that the cable connector is not off a row or a column of pins as shown below:



Off a row

Off a column

Most of the problems with disk drives occur at this point, so be careful and check the connection twice. Compounding the connection problem is the fact that the disk drive is the only part of the computer system that has a motor (two, actually) that gets its power from the computer. Thus, one of the pins on the disk controller card carries the power to run the motor in the drive. If this power is misdirected via an improper connection to a sensitive chip there is smoke, smell and a ruined chip to pay. (One consoling note, though, the chip that usually blows costs less than two dollars. See chip swapping - Chapter IX.)

12. Double check connections before turning on power. If you are working with someone else, have your partner check over your setup. Be sure to check cable connections for proper alignment.

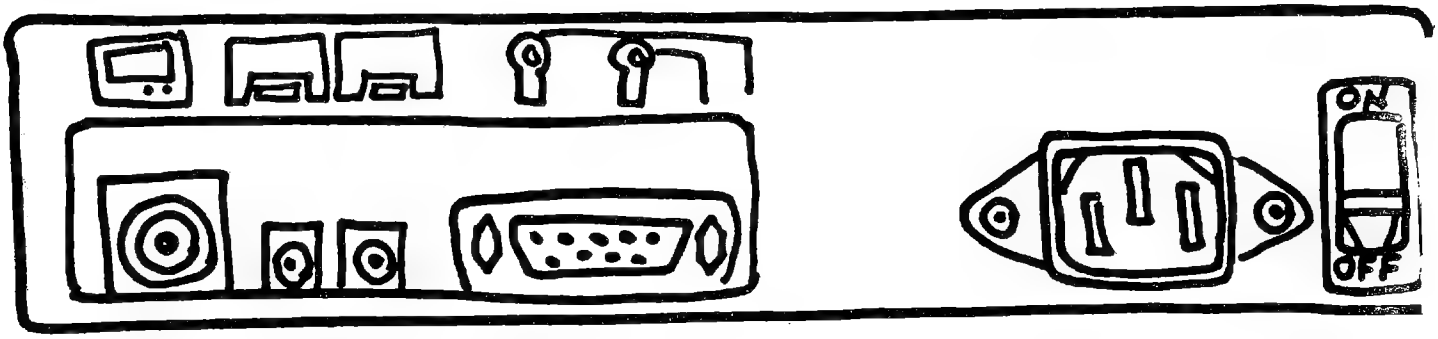
Have Your Partner Check Your Setup

Stripping down the Apple

Now to bare the computer to your eyes! Be sure to follow the tips listed above and work slowly and carefully at this stage. Notice markings on the cards, chips, and other devices. For this exercise I will assume that there is a printer, paddles, joystick, or pad, and a standard Apple monitor. If there is additional equipment tied to the system read your directions for working with it. Refer to the main board diagram at the end of this chapter for help in locating parts.

1. Remove the power cable from the computer and unplug power cords to the printer and monitor.

2. Disconnect the video cable from the computer to the monitor and set the monitor and cable aside. Note where they were connected.



Video Tape Paddle/Tablet Power Port On/Off

3. Remove the disk drive card. This is usually in slot six.

4. Disconnect the drive cable(s) from the pins on the interface card. Its easier to remove the cable connections from the interface card after it has been removed from its slot. This gives more room to grab the connectors.

5. Set aside the disk drive(s) and card.

6. Remove the 80 column card in the auxiliary slot - the slot that is all by itself. This card is used for the 80 column display and, if you have the extended card, an additional 64K of memory. Set aside the card. NOTE: Some computers will not have a card in this slot.

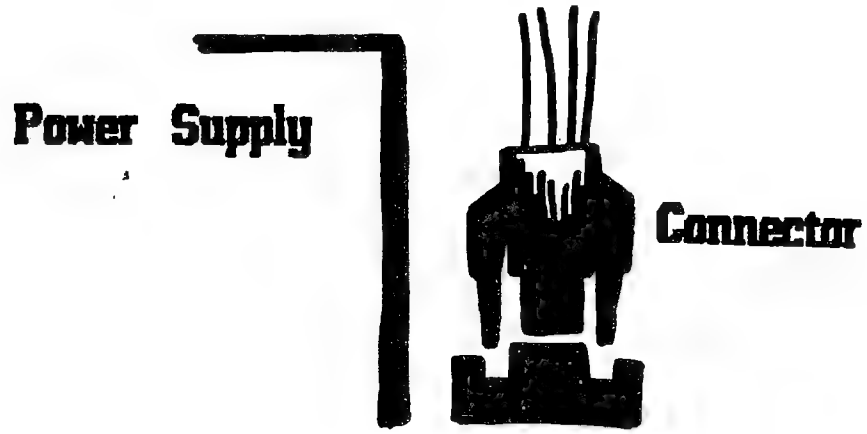
7. Remove the printer card. It is usually in slot 1. Disconnect the printer cable from the card. Some of the printer connections are similar to the disk drive connection but others have special small locks to hold the cable in and/or notched sockets that prevent improper connecting of the cables. Examine the connection carefully. Set aside the printer interface card, cable and printer.

8. Not much left! If you have a connection such as a joystick, paddle, or pad in the I/O port- the white one on the right back side of the computer- remove it and set it aside. If you have the paddles that are connected on the outside of the computer remove the device.

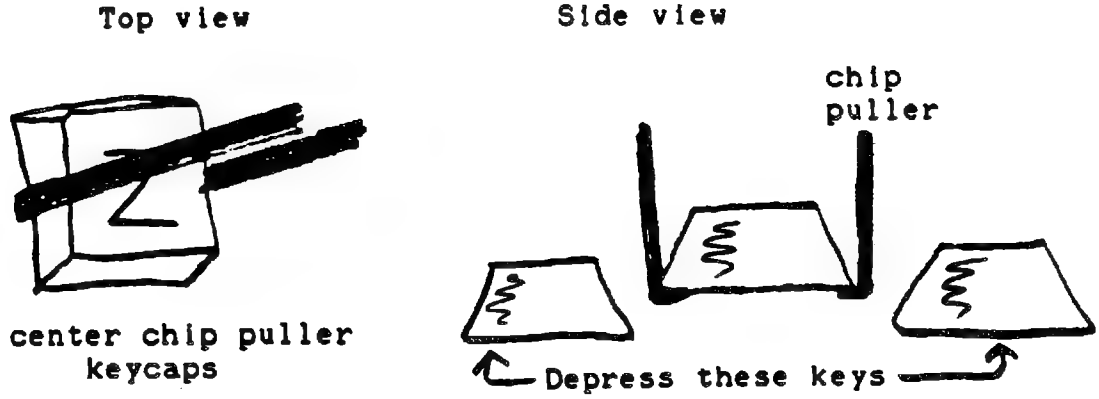
9. Find the speaker. It is underneath the keyboard. Follow the two wires from the speaker to the other side of the computer. Disconnect the speaker by pulling up on the connection. (Note: This connection can be put back on without regard to pin orientation.)

10. Find the wide cable that runs from the keyboard to a socket on the middle right side of the computer mainboard. This cable connects the computer keyboard to the the main board. Disconnect the cable. This is usually a bit tough to get out of the socket. Try using a knife edge to work it loose.

11. The metal box on the left of the computer is the power supply which changes the shocking voltage and amperage coming from your house current to a pleasant amount suitable for a friendly computer. To the right of the box and near the back is the connector that joins the power to the main computer board. The power connector snaps into this socket. To remove it, squeeze the two plastic snaps and pull. See below:



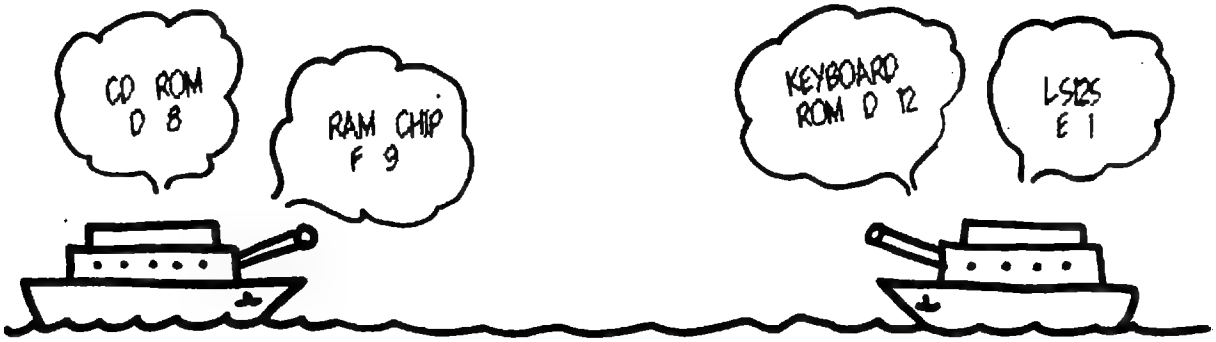
12. Now for the key caps! If you are a teacher or you have prankish offspring this is a must. Remove one of the keycaps by depressing the two keys to its left and right and inserting the chip puller under the cap and centered over it. Carefully pull straight up. The stems of the switches do snap off so accent "straight up" when doing this. Also, leave the space bar for later - if at all. It has a stiff wire under it to even out the pressure when the key is stroked. It isn't a simple task to get all the pieces back together, so wait until you need to fix it!



Removing Keycaps

Well, that is it! Now that it is torn apart lets examine the details from a functional point of view. Examine the green board inside the computer. On the left edge of the

board are letters A to F and on the bottom are numbers from 1 to 14.



These letters and numbers are used to identify parts on the main board just like in the familiar game "Battleship". For example, the large chip in the lower left corner (it says "Video ROM" just above it) is in row F and column 4 so its location is [F4]. Try finding the chip at location [C12]. The number above it is LS251. Tricky huh! Even the Apple interface cards are labeled in a similar manner.

Now look at the computer system as four main parts. Within each box are the pieces of hardware or chips that make up that part. Each main board part is located with a grid number as described above.

INPUT

Keyboard [C14]

Paddle port [A14]

CENTRAL PROCESSING UNIT, etc.

CPU (6502 chip, [B4])

Random Access Memory (RAM)
[Row F, chips 6 - 13]

Read Only Memory (ROM)
[D8, D10, D12, F4]

STORAGE

Cassette Recorder (not used often!)
[back of Apple]

Disk Drive(s)
[Slot 6, standard]

OUTPUT

Speaker [F14]

Printer [Slot 1]

Monitor
[Video socket]

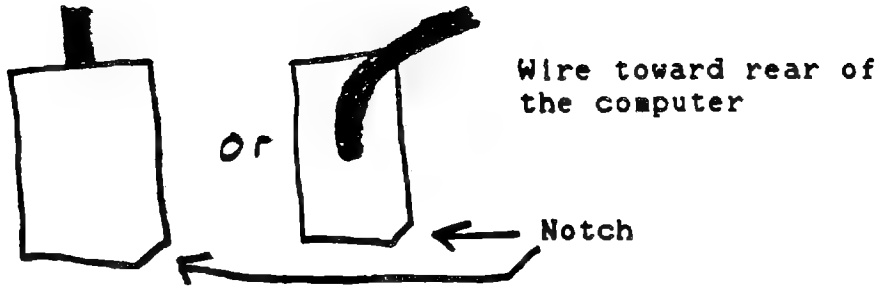
Each of these areas of the computer are made up of a number of modules which are denoted with dotted lines in the above diagram. The goal of the repair procedure is to reduce a computer problem to one of these modules. First, though, you need to know what each module does. Here is a brief description of these components, their functions and some of the problems they exhibit:

** Keyboard **

As the keys are pressed, codes are sent to the main board through the ribbon cable. If only one key doesn't work properly (i.e., no response on the screen or two or more characters appear) then the problem is usually the keyswitch under the offending keycap. If two or more keys suddenly take ill then the problem is usually on the main board.

** Paddle port **

Usually paddles, joysticks, or pads (Koala, Chalkboard, etc.) are attached to the connector at A14. If the paddles don't work, check the orientation of the connector. Chances are it was turned around. Most of the paddle connectors have a notched corner which should be toward the keyboard when inserted. Also, the wires usually lead out of the connector toward the back of the computer. These connectors also like to sacrifice pins to the repair gods. Move paddles, joysticks, etc. as little as possible to avoid damage.



Proper assembly for Paddle port

** Speaker **

If the speaker doesn't work, check the connection to the main board. Sometimes only one of the pins is connected.

Off one pin Correct position

Connection for the Speaker

** Printer and Interface card **

Signals for the printer are sent out through the slot filled by the printer interface card. If the printer is malfunctioning the problem is usually the interface card, the ribbon cable or the printer itself.

** CPU **

This chip, located at [B4] on the main board of the computer is the brains of the system and controls the action of the computer. Somewhere on the chip should be printed "6502" which tells you what type of processor is in the Apple. I have encountered only one bad CPU in four years of working with 200 Apple computers.

** RAM **

The RAM (for Random Access Memory) is a set of eight chips on the main board where information is stored. These chips are located at F6 through F13, have a white bar above them, and are even labeled with "RAM". When the computer is turned off, this information is lost. If the computer looses information when on or random characters pop up on the screen a faulty RAM chip is usually the culprit. The extended 80 column card also has a bank of RAM chips.

** ROM **

The ROM (for Read Only Memory) chips permanently store information for the computer to use when running. For example, when the computer is turned on, the BASIC computer language is available. The directions for this language is stored in the ROM chips. These chips are labeled on the main board and are usually the larger chips.

** Cassette Recorder **

Yes, the Apple computer can use a cassette recorder for storage of information. The cassette jacks are next to the monitor connector in the back of the computer.

** Disk drive and interface card **

This is the standard device used for storage on the Apple. The old standby single drive unit and the duodrive are available for the Apple. Both use the same concepts. If you are having trouble with the drive the problem in most cases is in the interface card, disk drive, or the disk itself.

** Power supply **

As mentioned previously, this device provide the juice for the brains. If the computer will not ignite when you throw the switch - then this little box is usually at fault.

** The Disk **

These can be considered an extension of the disk drive. Each disk provides storage for information. A description of disks and their problems is given in chapter VII.

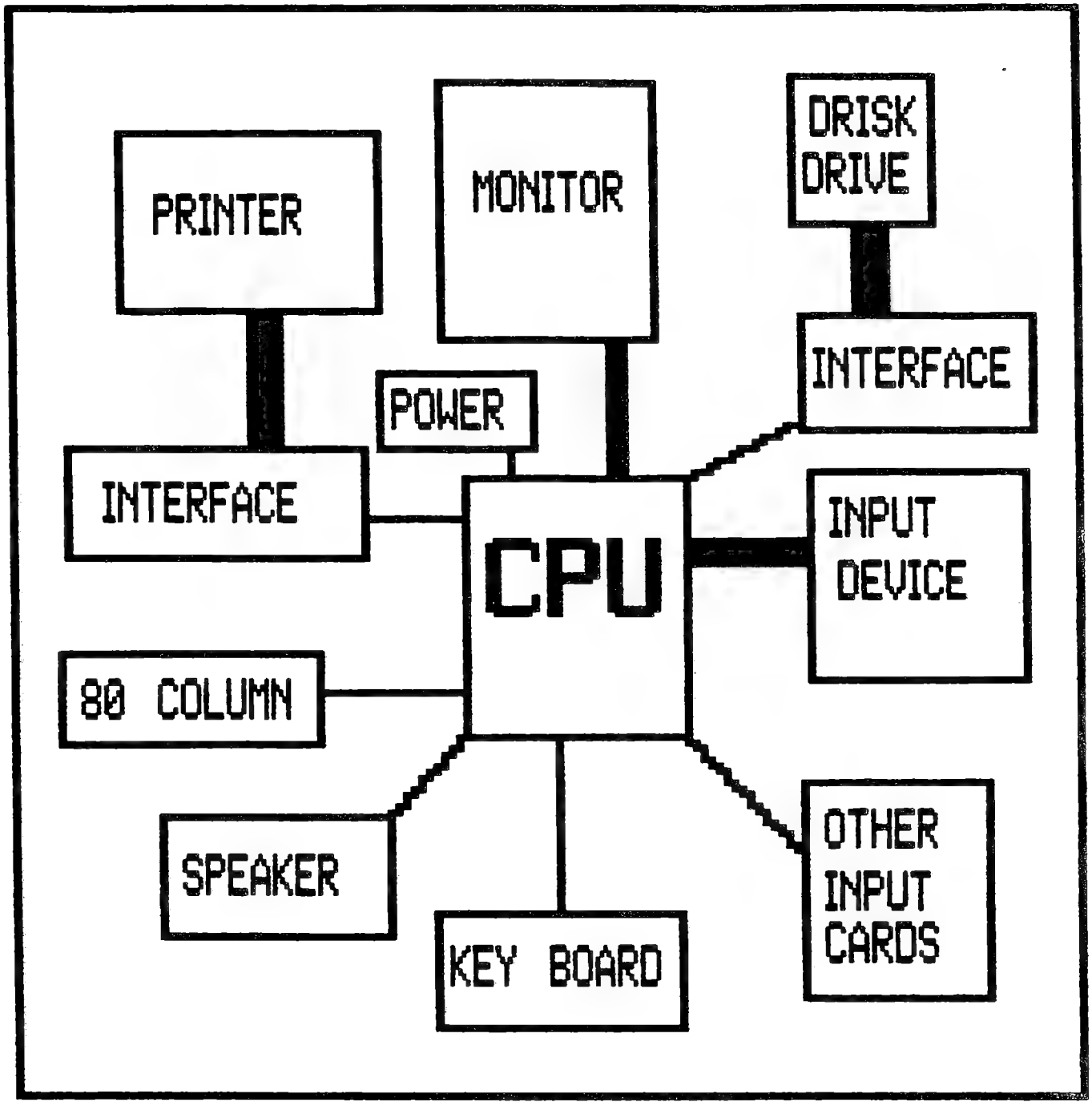
** The Operator **

This device is usually located in front of the keyboard and contributes vital information to the system. Problems usually occur when this component has been left on too long and one of its chips burn out. Erratic keyboard responses, spilled material such as coffee or beer, and groans and cursing are sure signs that this part needs to be repaired.

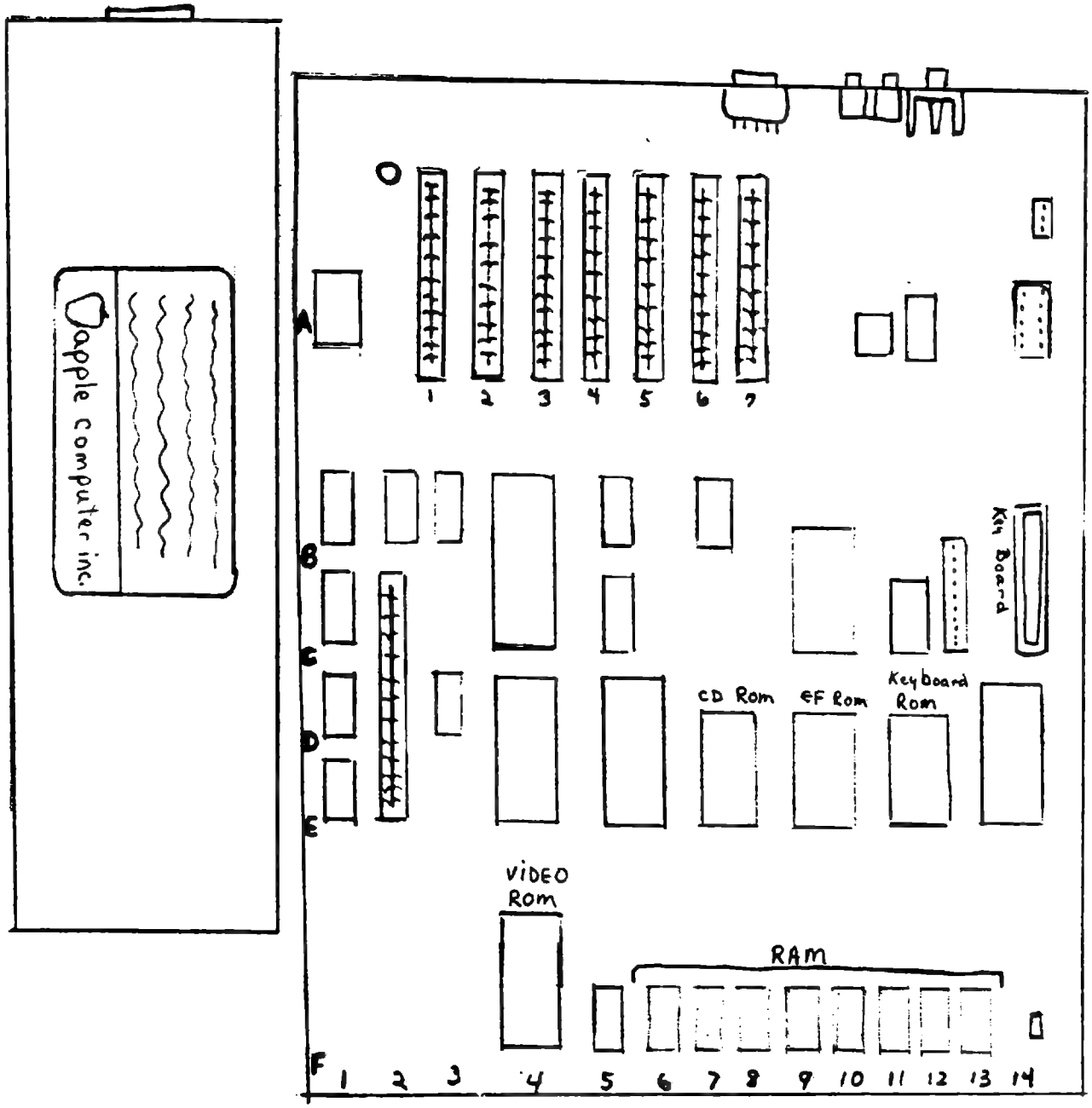
With all of these parts scattered about, view the computer system as a set of modules. They are the CPU, power supply, speaker, keyboard, printer, printer interface card, disk interface card, disk drive, 80 column card (or extended 80 column card), monitor, paddles, disks, and each of the cables that pull all these components together. Part of the diagnosing procedure is to narrow the problem in the computer system to one of these parts (See the next page for an illustrated view of this concept).

Satisfied now that what you have torn apart and placed in front of you may be the same computer I am describing, put the pieces back together. Start with the hard to reach connections, such as the paddles, keyboard, and speaker wires. Then put the cards back in. Be sure to put the 80 column card in with notched corner toward the keyboard. Remember to double check connections!!

MODULAR LOOK AT THE APPLE SYSTEM



MAIN BOARD DIAGRAM



Chapter IV: What if ...

The purpose of this chapter is to explore what a properly functioning Apple IIe computer should do in different configurations. The process of repair used in this book is to isolate a defective module and this process requires knowledge about how the Apple normally responds in different equipment configurations. For example, with no disk drive connected, what will happen when the computer is turned on? Will the computer beep? Will the control-reset key function? This chapter will provide information that will be instrumental in answering these questions and diagnosing computer ailments. It will also help to develop your understanding of how the Apple computer works, as well as give descriptions of controlled tests for working with different system configurations.

** Procedure **

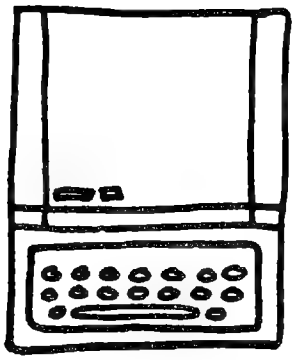
Read each "SETUP" and configure your system accordingly. Be sure to follow the recommendations listed in Chapter 3. Then do the "TESTS" described below each setup and compare the response of your system with that described under "RESULTS". If you would like to check you powers of observation cover the "RESULTS" section and mentally note what happened and then compare with my description. At the end of the chapter is a summary sheet of all these tests for easy reference.

These components are used in the following setups: Apple IIe, 80 column card or extended 80 column card, disk drive, disk drive interface card, printer, printer interface card, monitor, paddles, joystick, or pad, and a system master disk. If you do not have a particular component, skip that section.

Note: The bracketed R, [R], means press the RETURN key.

Double Note: If the system freezes (nothing happens on the screen and individual keys have no effect) then press the control and reset keys at the same time.

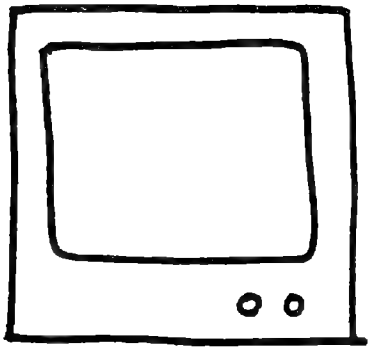
*** SETUP #1 **** --> Naked!



Remove all the cards from their slots and any paddles or joysticks from the I/O ports. Disconnect the monitor cable. This is the bare bones system. How does the computer tell you it is alive? This observation is important for some repairs on the Apple.

--------TEST----------	----------RESULTS----------
a. Turn on the computer.	Computer beeps.
b. Type CATALOG and [R]eturn.	The computer beeps.
c. Type PR#6 and [R].	No sound from the computer and RETURN does nothing.

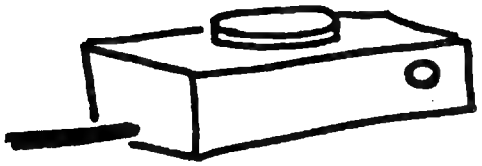
*** SETUP #2 ****--> Almost Naked



This is the same setup as #1 but with the addition of the monitor.

--------TEST----------	----------RESULTS----------
a. Turn on the computer.	The computer beeps. "APPLE][" appears in the top center of the screen and "]" is in the top left of the screen.
b. Type CATALOG and [R]eturn.	"SYNTAX ERROR" appears and a "beep". See Chapter VII on DOS.
c. Type PR#3 [R].	Computer freezes. Press control-reset to get cursor back.
d. Type PR#1 [R].	Computer freezes.
e. Type PR#6 [R].	Computer freezes.

*** SETUP #3 ****--> Paddle Tester



Same as SETUP #2 but plug in paddles, joystick or pad.

--------TEST----------RESULTS----------

a. Do SETUP #2 tests. — Same results as listed under SETUP #2.

b. Enter this program:

```
10 PRINT PDL(0), [R]
20 PRINT PDL(1) [R]
30 GOTO 10 [R]
```

* Type RUN [R], move controls or press pad.

Two columns of numbers appear. Values range from 0 to 255. Many of the devices do not cover this full range so expect some deviation.

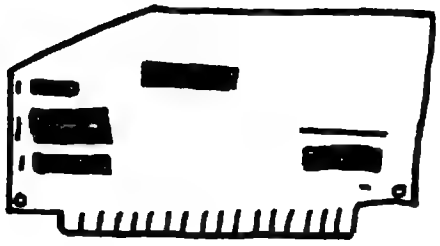
c. Type NEW [R], enter this program, and press [R] at the end of each line.

```
10 PRINT PEEK(-16285),
20 PRINT PEEK(-16286),
30 PRINT PEEK(-16287)
40 GOTO 10
```

Three columns of values appear on the screen. If no buttons are pressed on the paddles, joysticks, or pads the values will all be less than 128. When one or more buttons are pushed one or more columns will display values greater than 127.

* Run [R] program, push buttons on controllers.

*** SETUP #4 ****--> 80 column Card



Same as SETUP #3 with the addition of the 80 column card or extended 80 column card in the auxiliary slot. Be sure the notched edge of the card is toward the keyboard.

--------TEST----------RESULTS----------

a. Do TESTS a and b as described in SETUP #2. — Same as listed in SETUP #2.

b. Type PR#3 [R]. — Changes display to 80 columns, cursor is in upper left corner. (Ah-ha! PR#3 turns on the 80 column display. Use PR#0 to return to 40 columns.)

c. Hold the [R] key down for ten seconds. — A column of "]"s flows up the left side of screen. The rest of screen is clear.

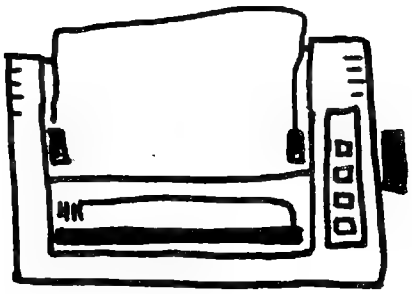
*** SETUP #5 ****--> Printer card

Same as SETUP #4 with the addition of the printer card in slot 1. Do not connect the printer cable.

--------TEST----------	----------RESULTS----------
a. Do tests a and b as described in SETUP #2.	Same as in SETUP #2 results.
b. Type PR#1 [R].	Computer freezes.

*** SETUP #6 ****--> Printer

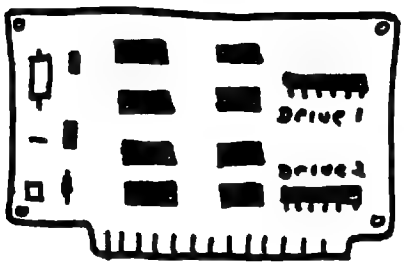
Same as SETUP #5 but this time connect the printer to the printer interface card. Turn on the printer and be sure it is on line to the computer.



--------TEST----------	----------RESULTS----------
a. Do tests a and b as described in SETUP #2.	Same results as in SETUP #2.
b. Type PR#1 [R].	Printer usually jerks or makes a sound. Screen either displays] or no cursor. (Another "Ah-ha! PR#1 turns on the printer. Use PR#0 to turn off the printer.)
c. Type TESTER [R].	Printer prints "TESTER", beeps and prints "SYNTAX ERROR" on the next line.
d. Type PR#0 [R].	Printer stops action and cursor returns to the screen.

*** SETUP #7 ****--> Disk Drive Interface Card

Same configuration as in SETUP #6 but with the disk drive card in slot #6. Do not connect the disk drive cable to the card.

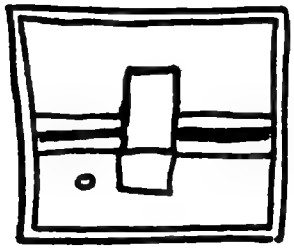


--------TEST----------RESULTS----------

a.	Turn on the computer.	"APPLE][" appears on the screen and the computer freezes. No beep and no "]". Press control-reset to get cursor back.
b.	Type CATALOG [R].	"SYNTAX ERROR" is displayed.
c.	Type PR#6 [R].	Computer freezes.
d.	Type PR#3 [R].	Activates 80 column display.
e.	Type PR#1 [R].	Activates printer

*** SETUP #8 ****--> DISK DRIVE SYSTEM

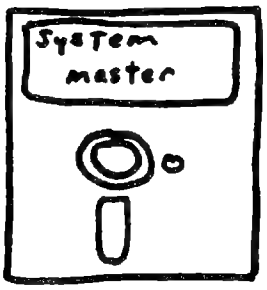
Connect the disk drive cable to the disk drive card described in SETUP #7.



--------TEST----------RESULTS----------

a.	Turn on the computer.	"APPLE II" appears on top of screen, it beeps, and the drive and drive light come on. Press control-reset to get cursor back and stop the drive.
b.	Type CATALOG [R].	"SYNTAX ERROR". See chapter VII for explanation.

*** SETUP #9 ****--> Disk System with DOS



Put the System Master disk into the drive in the configuration described in SETUP #8 above.

--------TEST-----------------------RESULTS----------------

a.	Turn on the computer.	"APPLE][" appears on the screen, it beeps, and the drive and drive light come on. After a short delay and some messages the cursor appears.
b.	Type CATALOG [R].	Drive comes on and a catalog is displayed on the screen.

Become familiar with the computer responses that should happen. During the diagnostic sessions in future chapters any response contrary to the expected can be a key to the problem. Also, note that peripherals- printers, drives, paddles, etc.- can be accessed independent of each other. You should also be developing some strategies for great practical jokes to play on other Apple][folks! You can imagine the fun that moving a printer card to a different slot can create!

On the next page is a summary of the work described in this chapter. The tests are listed across the top and the 9 different setups are on the right side. Though my descriptions didn't cover all 7 tests for all 9 setups, try some of them. Some of the results are very interesting.

One test tidbits not mentioned above is to type PR#5, PR#7 or any other unused slot number. The PR#6 tells the computer to go to the sixth slot, which usually cuddles the disk drive interface card, and get some action going. But what happens if the disk drive is hooked to slot 6 and the other unused slots are accessed? We have done this in a variety of our workshops with some unexpected results. Give it a try.

A RESPONSE GUIDE TO A GOOD APPLE

SETUPS ↓	TESTS → #1	#2	#3	#4	#5	#6	#7
	Turn on computer	Type CATALOG	PR#3 & RETURN	PR#1 & RETURN	PR#6 & RETURN	10 PRINT PDL(0)	PEEK (-16285)
1. Naked Computer							
2. Add the monitor							
3. Add paddles							
4. Add the 80 column card							
5. Add printer card							
6. Add the printer							
7. Add disk drive card							
8. Add disk drive							
9. Add a disk							

Chapter V: So You Have a Problem...

Apple provides a three day training program in repair and maintenance of their computers. This qualifies a person for Level I repairing which is what most computer stores provide. I went through this training.

Upon arriving, we students were greeted by our trainer. She then introduced us to three of Apple's technicians. One was a Level I technician, one a Level II, and one had Level III status.

Our host, as a way of introducing us to the training program, began a demonstration of what the three levels of repair could accomplish. First, an Apple computer was opened up and put on the floor and one student was selected to stomp on the computer. You could hear parts snap and crack, chips zipped across the room- what a mess!

Then the Level I technician picked up the pieces and placed them on the bench and went to work. Chips and parts flew and in 15 minutes he hooked up the monitor and turned on the power. Lo and behold, the Apple][Logo came up on the screen! It was a little crooked and there was no color, but the text was readable. We all clapped in amazement.

Next, the Level II technician went to work on the computer. After 10 minutes of intent effort she snapped on the computer lid and switched on the power. It came up like a new machine. The monitor displayed clear color and text and the system performed all the tests perfectly.

Finally, the Level III person took over. For twenty minutes he poured over the computer with feverish intensity. Then flipped the switch. The screen came on just as it had done for the previous technician.

We were a little perplexed as to what was fixed this time. Finally the fellow next to me spoke up, "I don't understand! Your Level III technician spent 20 minutes repairing the computer and got the same results as your Level II person. It seems like a waste of..."

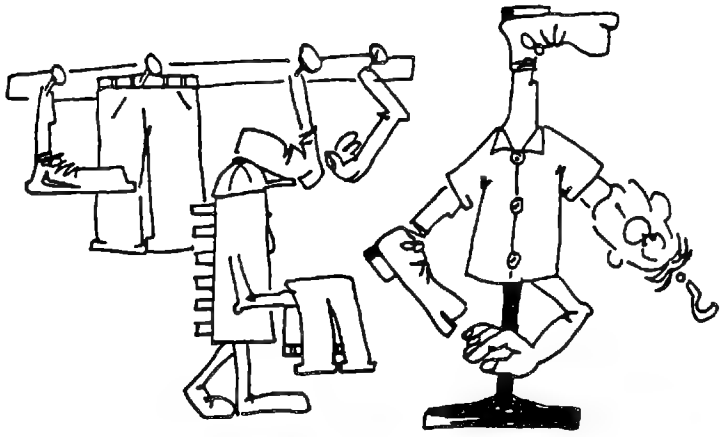
Suddenly the lights dimmed and a flash of light blasted the chair from under the questioner. Moments later the dazed student was sitting on the floor amid the charred remains of his chair when we heard a strange voice come from the computer, "Anyone else, Master?"

Now is time to solve those nagging problems in the computer. This three part chapter is designed to do just that for most of the problems that occur. The first section outlines steps that can be taken without a second computer and without tearing your system down. In the good old days of the Apple II and II+s these remedies would have solved 90% of the problems. With the IIe this percent is not quite as high. To solve problems, though, it is best to take the course of least resistance and exhaust all these possibilities. Most of the suggestions involve observing the setup of the system and reseating connections.

The second part of the chapter describes how to isolate a troublesome module. An example of the technique is given, so you can try the test on your own system. The last section describes specific symptoms and possible solutions for each malady. The end results of this chapter are two fold:

(1) You will be able to find a faulty module (cards, cords, devices, etc.) which, in many cases, does not require you to give up your whole computer to the repair shop munchkins. If you are a brave soul and supplied with replacement parts you could, in most situations, fix the module yourself.

(2) You will have learned a technique for repairing computers which will carry over to symptoms not described in this chapter. These methods will even apply to problems in other makes of computers. In fact, the techniques would work well even for non-computer related problems.



Non-Computer

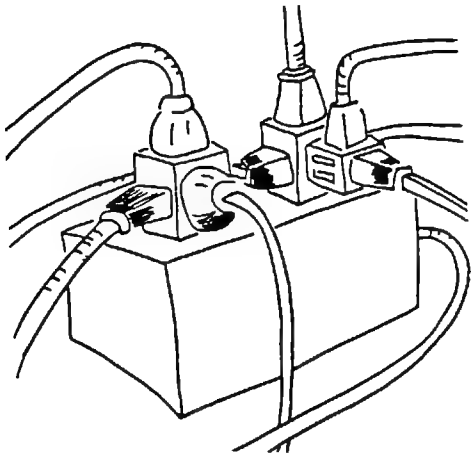
Related Problem

Section 1: SIMPLE SOLUTIONS TO TRY FIRST

Be sure that the power is off before doing any of the following suggestions.

1. Check cords, cables.

   Yes, check the power cord, the monitor cable, and check the power source. As one who is constantly using tools in building a house in which not all of the plug-ins are connected to the power, I have caught myself a few times with electric drills and saws torn apart, looking for phantoms when the real culprit was a dead wall plug-in.



2. Check for proper slots and connections.

   Some software will only work if the disk drive is in slot 6 (PFS, for example). Others require that the printer interface card be in slot 1. If you are having problems with printers not working on a few pieces of software, this might be the problem. Refer to the documentation for that software.

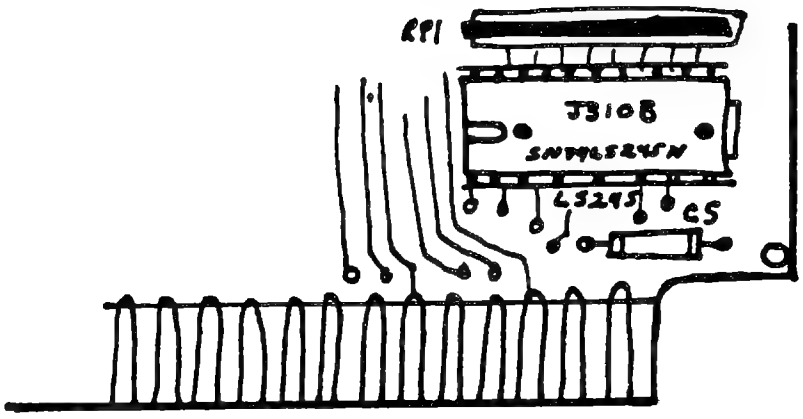
   The Apple computer always looks for the disk drive connected to the DRIVE ONE connector on the interface card in the highest numbered slot. Problems arise when the disk drive is put on the DRIVE TWO connection and there isn't a drive hooked to DRIVE ONE. The computer will freeze. This problem usually occurs when computers are moved around a lot and are constantly torn down and set up.

3. Reseat cables.

Specifically, check the disk drive cable on the interface card, the printer cable on its interface card, the keyboard cable on the main board, and the power supply snap-in connection to the motherboard. As the computer is bounced around during educational game playing or word processing, these connections tend to work loose. Press the cable connections firmly onto the pins and try the computer again. This cures many problems.

4. Reseat slotted cards.

Remove the 80 column card from the auxiliary slot and look at the gold plated contacts.



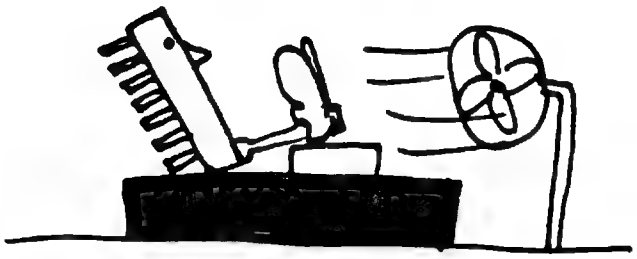
Contacts

Herein lies the source of some computer problems. As electricity flows from the computer to the cards in the slots, a small amount of corrosion, or guck, develops. Over time this corrosion can build up to the point that it interferes with current flow. If you suspect a "dirty" card, there are a number of ways to treat it. When in a hurry, just take the card out and then re-insert it. If you have some time, clean the surface with tape cassette head cleaner. One other suggestion is to use a soft eraser and gently erase the guck from the contacts. Take your pick.

5. Chip pushing.

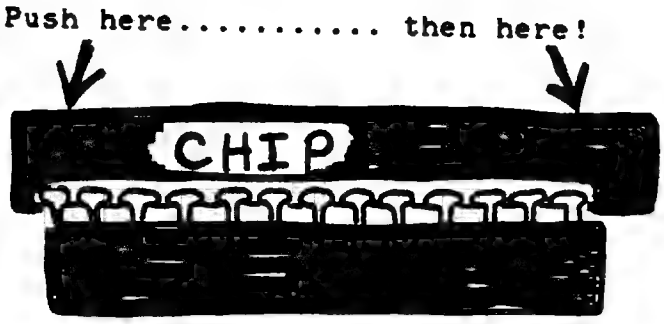
The flow of electricity through the chips on a computer produce heat. In the old Apples, with their 108+ chips, one of the features rarely mentioned was the computer's ability to soft boil an egg placed near

its hot chips. Some people purchased small fans to cool the little chippers down. In addition to creating a lot of heat, the constant heating and cooling of the chips caused them to creep right out of their sockets! I have seen some that were just sitting on top of their sockets and barely making contact.



Boy, it's hot in here!!

The IIe computers require the addition of a hot plate to boil eggs but despite the lack of extreme heat, the chips do tend to work their way out of their sockets. To get those chips back in place it is necessary to resort to pushing and shoving. To do this, first press down on one end of the chip and then the other. If it has been a while since this has been done, you will feel the chip slide into its socket. The chips on the interface cards, 80 column cards, and disk drive also can be pressed back into active service as well.



If one time the computer works fine and the next time it shows you Greek hieroglyphics or decides to take a trip into machine language (a star pops on the screen instead of the familiar bracket cursor) then start pushing those chips! This erratic behavior indicates that the electrical flow is being interrupted at the whim of a troublesome contact. Usually these types of problems occur after the computer has warmed up. (Caution: Be sure to follow the directions given in chapter 3.)

6. Check the disk.

Are you using a disk that is compatible with your system?? There are still some DOS 3.2 disks running around that won't boot on your IIe system. Is the disk blank, physically damaged (look for scratches, or marks on the surface) or just out to lunch? Always double check your disks and try them on another computer to see if the problem is in the computer or the disk. See chapter VII for more information about disks.

7. Adjust the Monitor.

Most monitors have at least two adjustments- contrast and brightness. Be sure to check these for a proper display. This is another great computer gag- turn down the bright and watch panic stricken computer owners curse the day they bought their systems. This is also a good time to make an exorbitantly low offer to purchase their system!

To correct the bright and contrast settings, first turn the bright adjustment so it is in the middle of its turn and try the contrast in both directions until you find a picture. When (and if) you find a picture, then adjust both knobs to suit your needs.

Also, most monitors shipped with the Apple have vertical hold and vertical size adjustments. Try turning the vertical hold control knob located on the back of the monitor while text is on the screen. The picture will appear to roll off the top or bottom of the screen. If you turn it enough, the picture will appear somewhat normal but will flutter. The screen is flipping over so fast that it almost appears to be stable. This is a cheap technique for producing animation with a computer! Now that you know what to look for, get the display back to normal.

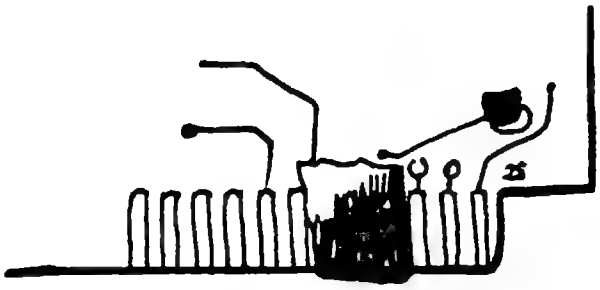
The vertical size of the screen can also be changed. If the top and/or bottom of the screen seems to be tucked behind the picture tube or 24 lines of text are scrunched into a one inch horizontal strip on the screen it is time to adjust the display size. Reach in back again and turn the vertical size control to see the changes that can be produced in the display.

Section 2: PROCEDURES FOR DIAGNOSTICS

So much for the easy answers to most of the problems that are encountered with the Apple. If these don't solve the problem it is time to do some serious thinking and begin the diagnostic process. Remember, it is very helpful to have two computers available, as well as two people. It is also assumed that you have exhausted the tricks described above. The purpose here, is to isolate the bad module in the computer system. The procedure is two fold:

(1) Work with the sick system until a suspected part is located.
(2) Remove that part and test it in a good system (hence the desire for two systems).

To demonstrate this strategy set up a computer as follows: the printer interface card is located in slot one and is connected to the printer. Connect the disk drive cable to DRIVE ONE on the interface card. Insert a good test disk. Now, remove the disk drive interface card. Use a one inch piece of half inch transparent tape and cover at least three gold contacts on both sides of the keyboard end of the card. Insert the card in slot six. Now, forget you did this and proceed.



Bugging the disk drive card

Five Steps to Diagnose Problems

Step 1: OBSERVE *Turn on the computer and note the situation. What is displayed on the screen and how do the peripherals respond? How does your observation compare with what you know should happen?*

In this example the computer beeps and the "APPLE][" logo appears in the center of the screen. The cursor is in the upper right corner. The computer

responds as though there isn't a disk drive card. A problem exists and seems to be in the area of the drive.

Step 2: REMOVE PARTS *Remove parts (cards paddles, etc.) until the system works properly. Many times all the insides will need to be removed.*

In your set up, remove the printer card and turn on the computer. Still the same response. Remove the 80 column card and turn on the computer. Again no change. Now remove the disk drive card and note that the response is as it should be. The drive still didn't work with the other parts removed so those parts are probably ok. The drive and its card are prime suspects.

Step 3: SEPARATE PARTS *If an interface card and its device (printers, disk drives) are suspected disconnect the device and test the card.*

In the example, disconnect the drive and turn the computer on. Same screen. The card is not responding as it should. ----->SUSPECT!!!<-----

Step 4: TEST Test each of the suspected parts in a known good system. Test only one part at a time.

In this case, test the suspected disk card in a good machine. Remove the good disk interface card and insert the suspected card and connect the good drive to it. Turn on the system. This computer responds the same as the bad system. The interface card is bad. Now check the drive. It could also be bad. Test it by restoring the good computer to its original configuration (i.e., remove the bad disk drive card and put the good one back in). Then plug the "suspected" drive in. It should work fine.

Step 5: HELP! *If no bad modules are found, then the computer is bad and requires more technical help.*

No action was necessary in the example since the problem was resolved. In a few cases, though, all of the modules will test fine, leaving you with a bad computer. Either you can take a closer reading of this book and refer to chapter IX, chip swapping, or take the unit in to your service center for repair.

Well, that's about it. You should feel like a detective interrogating suspects. What a chance for testing your problem solving skills. Have a positive attitude!

But one caution!!!!! Remember to always restore your systems back to their original components. Step 4 requires shuffling parts around. When you are finished be sure the parts left in the good system are its original parts. The same goes for the bad system.

/--\
: Section 3: SOME SYMPTOMS AND WHAT TO CHECK :
\--/

Of course, it would be difficult as well as impossible to list all the symptoms of illness in a computer system. In fact new ones keep cropping up all the time. But with the above steps in mind and the list of symptoms described below, you should be well on your way to diagnosing most of your problems.

To use this section for diagnosing your equipment, find a symptom similar to yours and then follow the suggestions listed below the symptom. If your symptom isn't listed then use the preceding five step diagnostic approach.

Monitor Problems

SYMPTOM: Monitor is blank and none of the monitor indicator
A lights are on. Computer light is on.

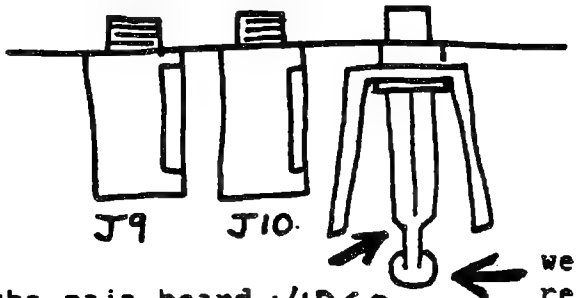
** Suggestions: Since the power light is not on the problem is most likely in the monitor or a faulty power source. Check the power cord to the monitor. Occasionally, the power cord is bad and can be replaced by a knowledgeable repair person. NOTE: Monitors and TVs are dangerous if you don't know what you are doing. Do not work on the internal parts unless you are properly trained! <<< This book doesn't give you that training! >>>

SYMPTOM: The monitor light is on, the screen is blank, the
B computer light is on, and the drive appears to be booting properly.

** Suggestions: Three possibilities come to mind, all of them related to the monitor connection:

1. Bad monitor cable. Remove the suspect cable and try it on a known good system. Also check SYMPTOM C for other possibilities.

2. Broken monitor connection inside the computer. Remove the lid to the computer and visually check the thin metal elbow that goes from the monitor port to the main board. It is in the back right corner of the computer near the paddle plugin.



Monitor connection to the main board

Sometimes the wire breaks at the elbow and must be soldered back together. To check for this problem turn on the computer and a known good monitor and wiggle the monitor connection at the metal elbow inside the computer. If the picture comes on you have found the problem.

3. Monitor is bad. Hook the monitor to a good system and check for a picture. If the picture doesn't appear then the monitor is bad and needs "professional" help.

If all of these led to a dead end, it is time to look into problems within the computer itself. Check that section.

SYMPTOM: C — Picture is good at times but then will flicker or even disappear.

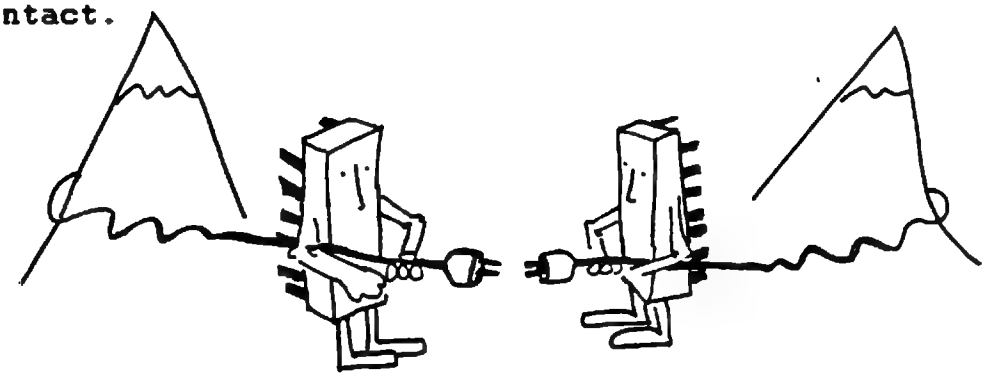
** Suggestions: Check these possibilities:

1. It could be a bad wire in the monitor cable leading from the computer to the monitor. Wiggle this cable and see what happens. If you affected the screen then chances are it is the cable. If you try it on a known good system with the same results you have found the rot in the system!

2. Check the slip on connections on both ends of the video cable. Often these hang loosely on their sockets, especially those with four metal leaves. To correct this problem bend each leaf in slightly so they make a tighter connection with the socket. Press each leaf against a large solid object (table, disk drive box, you daughter's Boy George record) and then try it again. Also, before throwing the bad cable away in number 1 above try this little trick.

Tightening the monitor connectors

3. Check the length of the snout on connectors and for damage to the connections. Some of the cable connectors have short center pins and do not make contact with the inner socket of the device. Again, try the cable on different computers and note if the middle pin is making contact.



Joddle Problems

(Short for joysticks, pads, I/O connected parts)

SYMPTOM: Joddles don't respond at all.
D

** Suggestions:

1. The joddles could be in backwards. Be sure the notch is facing toward the keyboard. See chapter III for an illustration.

2. A pin on the plug in could be broken. Visually inspect the connection. NOTE: Only nine of the sixteen pins are usually connected to the Apple, so a broken pin does not necessarily bring disaster.

SYMPTOM: One or more of the buttons or knobs on the joddle do not respond.

** Suggestions: Three possibilities:

1. A pin that is connected to the faulty button or knob is broken (See final comment).

2. A wire from the computer to the button or knob is broken. The break is usually inside the cable at the point where the wire enters the joddle.

3. The button switch or knob is broken.

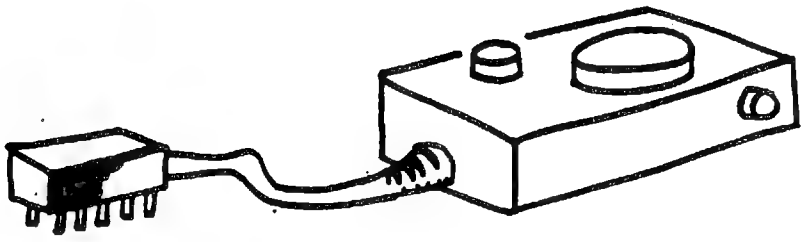
What to do? If the joddles cost less than $30 dollars donate them to a computer hacker to fix and buy a decent set. From the symptoms listed above you can get a good idea of what to buy.

Characteristics of good joddles

1. The set will have round, solid plug in pins with solid looking cables connected to the joddles.

2. The joddles will have a protective shield at the point where the cable enters the joddles to keep the wire from bending sharply. Let's face it, some of us get a bit excited when playing those educational games and jerk on the joddles to avoid colliding with flying space eggs or skudballs. Eventually the frail wires break inside their plastic covering at this critical point.

3. Buttons and knobs appear to be well made.



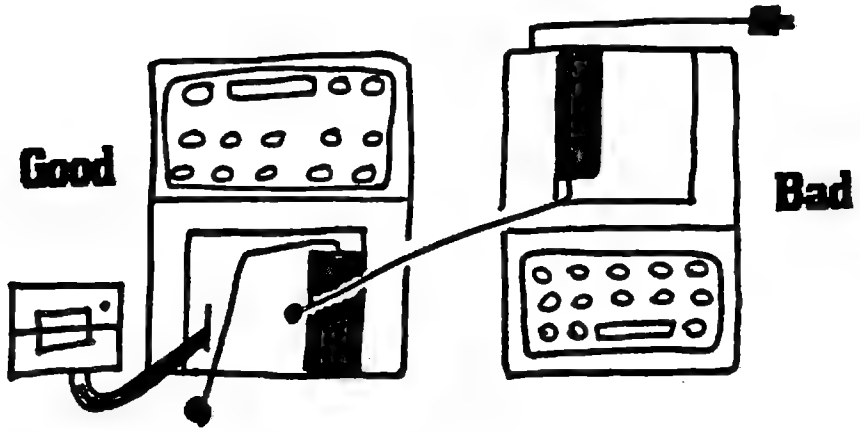
If you would like to try to fix a joddle, the bad wire can be cut out, the ends cleaned and resoldered to the buttons and dial. Most of the buttons can be replaced. Fixing the plugins, though, have turned into nightmares. Leave that to someone with a lot of time!

Computer Problems

SYMPTOM: No response when the power is turned on. The F screen is blank. No beep. No lights.

** Suggestions: Assuming the power source and the power cord are good, try these:

1. The power supply box may be bad. To check the power supply do the following:
   a. Disconnect the power supply cable from the main board in the bad computer.
   b. Do the same in a known good system.
   c. Carefully position the bad computer over the good one so that its power supply plug will reach the good system.
   d. Snap in the power supply cable from the bad computer to the good one.
   e. Connect a power cord to the bad supply system and turn on that power supply.



   If there is no response the power supply is bad and will either need to be replaced or the switch repaired (see 2 below). If the good system works with the suspected power supply, then something else must be wrong.

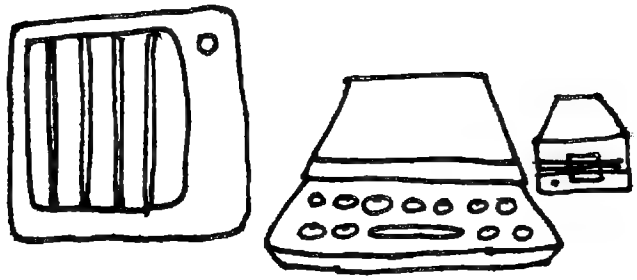
2. The power supply switch is bad. A bad power supply usually is the result of a faulty $2.50 switch. If the switch in the back of the

computer is hard to toggle and seems to move with a lot of friction then it is broken. Or, if you can wiggle it and get the computer to respond then it is time to replace it. Your Apple service center should be able to replace it quickly and inexpensively. If you can find a replacement switch you can also replace the switch by prying out the old one and installing the new switch.

SYMPTOM G: The Apple goes into the test mode. If you hold the control, reset and closed apple keys down at the same time the Apple computer goes into a built in test mode. The screen will change patterns for a few seconds and then the message "KERNEL OK" will appear in the upper right corner of the screen.

** Suggestions: Try removing the paddles, joystick or pads. If that doesn't work check all connections, and if the Apple test continues, follow the 5 step diagnostic procedure. See chapter 10 for an explanation of this particular problem.

SYMPTOM H: Vertical bars on the screen, keyboard dead.



** Suggestions: The problem is usually in the main board. If the 5 step diagnostic procedure isolates the problem to the main computer board, then three chips could be suspect:

Chip	Location
LS02	B-8
LS244	B-1, B-3
LS245	B2 (prime suspect!)

Refer to chip swapping procedures in Chapter IX.

SYMPTOM: Random characters appear on the screen. The
I keyboard is dead.

** Suggestions: This seems to be a problem with RAM chips at locations F6 through F13. Use the five diagnostic steps and if the problem is in the main board, then chip swap the RAM chips as described in chapter IX or take your computer in to your Apple service center.

SYMPTOM: One or more of the keys are malfunctioning.
J

** Suggestions: Two possibilities:

1. If a group of keys are malfunctioning the problem is probably the keyboard or the keyboard ROM chip at location D12. Try chip swapping (chapter IX) or take your system to the doctor.

2. If it is just one key, chances are it is a bad key switch that you can replace if you have the part, or can be quickly done at your local service center.

Disk Problems

SYMPTOM: The disk spins but will not boot. In some
K cases the smell of burning plastic curls about your nose.

** Suggestions: Assuming all other steps have been taken check the alignment of the disk drive cable on its interface card. If the connection is not on correctly the power for the motor in the disk drive travels (and burns) the circuits meant for much smaller amounts of current. The result is often melted chips in the drive that must be replaced. Check the integrated circuits inside the disk drive (see chapter VI) and chip swapping (chapter IX). Otherwise, the drive is destined for your repair center.

SYMPTOM: The computer seems to boot but then beeps and
L displays

I/O ERROR

or no message at all.

** Suggestions: Use the five diagnostic steps to isolate the problem. If it appears to be the disk drive, go one step more and check the disk. Try booting it in the good machine. Try a different disk in the bad computer. Sometimes the problem is the disk itself. Check the disk drive speed (chapter VIII). If that doesn't solve the problem take it to a service center for adjustment and be sure to take the disk(s) that caused the problem.

SYMPTOM: The computer catalogs and reads information off of
M the disk but will not save information. It will appear to do the steps necessary for saving, but CATALOGing the disk will show that the program has not been recorded.

** Suggestions: From my experience the problem is one of the chips on the disk interface card for the drive. Try the suspected card on a good computer system. If the results are negative proceed to your Apple dealer or to chip swapping (Chapter IX). Chip LS05 in location B-4 and the 9334 chip in C2 have been the culprits.

Printer Problems

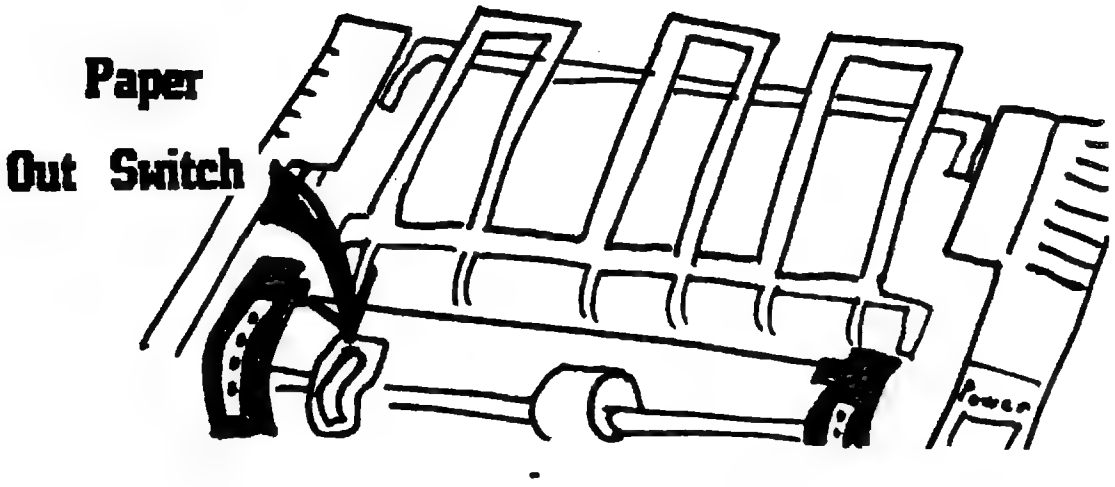
This section is difficult because there are many brands of printers, each with different buttons and switches. Most do have some common characteristics which will be highlighted here. Printer manuals are extremely important. Consult these manuals for help in diagnosing difficulties you encounter.

SYMPTOM: The printer is on and the computer freezes when it
N tries to print.

** Suggestions: Assuming the printer card is in the correct slot, the printer is on line, paper is in the printer, and the interface cable is connected properly check the following:

1. Is the paper feeding? Occasionally the paper gets jammed on the way to the printer and won't let the printer pull it forward. This will lock up the system.

2. Check the paper path. Often, inexperienced users don't feed the paper in correctly and the paper doesn't depress the "paper out" switch. If the paper out switch is on but paper is in the machine, check this out.



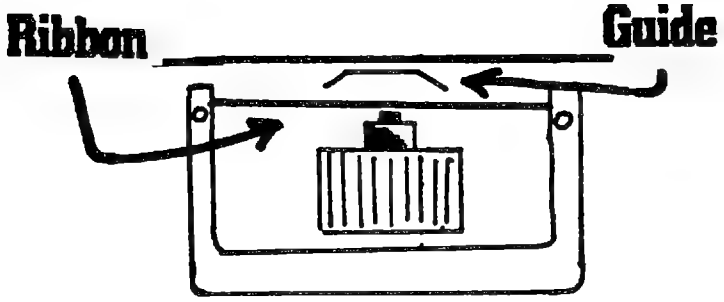
3. Check the fuse. Sometimes they burn out, other times people accidentally unscrew them thinking they are a switch, and occasionally practical jokers discover these gems.

4. Is the ribbon jammed or at its end? Some ribbons can go through the printer only once and then have to be replaced. When the end comes the printer usually signals in some way (a beep and/or light) and freezes the computer. These types of ribbons aren't used much any more.

SYMPTOM: The computer prints too light or to dark, or it prints dark but leaves a carbon streak on the paper.

** Suggestions:

1. Check that the ribbon is properly guided through the printer head. Smears usually indicate that the ribbon is rubbing against the paper. Most ribbons run behind a small metal guide to keep it away from the paper.



2. Most printers have a manual lever for adjusting the closeness of the head to the paper. This adjustment will change the degree of black printed. Refer to your printer guide.

SYMPTOM: The printer is not printing the correct symbols or graphics.

** Suggestions:

1. Printers and printer interface cards must be configured, or set up, for your particular computer. The cards and printers are designed to work on a large number of computers so many have switches that can be set for your particular computer. Refer to your manuals.

2. Software must also be configured for your particular printer or printer card. Most good software will guide you through this process. Refer to the manuals.

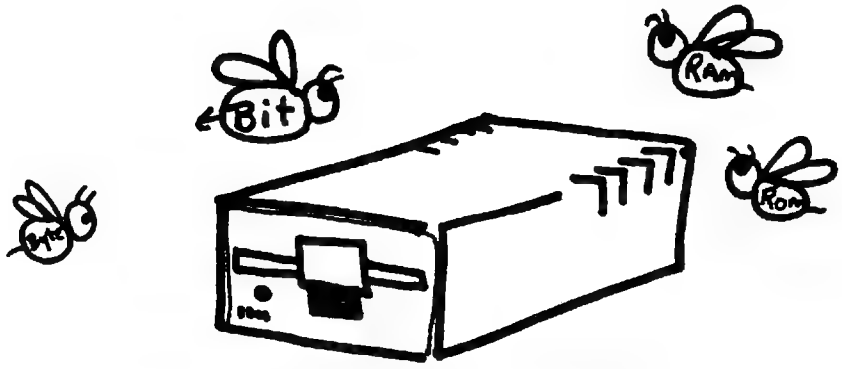
For further information on computer problems, refer to chapter X. Not only will more symptoms be described, but also how to duplicate these problems on your own system.

Chapter VI: Disk Drives

The disk drive gave the computer and the operator flexibility in storage of information. Before the advent of the drives on the Apple, the tape recorder was the poor substitute for storage. It was very slow and inaccurate. Along came the disk drive and freedom! Less time was spent on boot up and loading, access to information was easy, and, of course, exciting new challenges cropped up for the repair people.

The Apple disk drive makes the snake in the tree of Eden seem like a sissy. First, it lulls you with its unwavering accuracy not to make backups of your valuable disks. Then the bytes burp and your disk drive destroys your prized data. Why does this computer appendage cause so many problems?

The computer has no moving parts other than the switches on the keyboard, which are fairly simple in design and function. The disk drive, on the other hand, is a mechanical beehive with two small motors, a cam, sliding parts, and a spring loaded clamp. Motors get out of adjustment, springs break, and vibration affects the accuracy of the parts. It is a wonder they all hold together, but they do, through heat, cold, and bounces on the floor.



Mechanical Beehive

The success of the mechanical parts become even more amazing when you realize the accuracy that is expected from the drive. The information stored on the disk is stuffed onto a one inch wide band on its surface. The drive must be able to find any one of over 143,000 pieces of information stored on the disk. And it can't take all day!

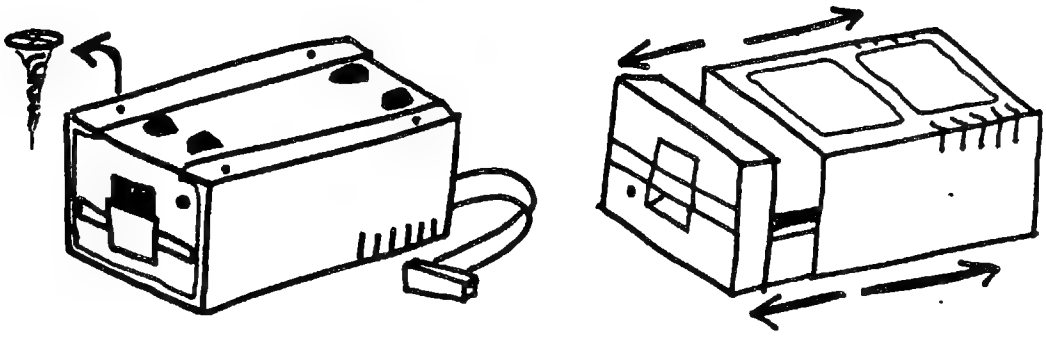
In its never ending battle to find and store information on a disk it must continually fight static electricity, vibration, heat, cold, exploring fingers inside the box, and

dirt. It must also take the shock (literally!) of being blasted away when it is incorrectly connected to its interface card. With all of these challenges it is a wonder that the drive works at all!

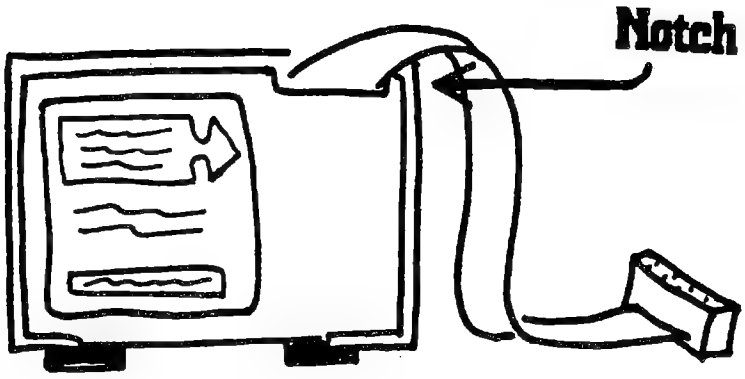
This chapter will describe the parts, the amazing magic they do, and the types of problems that occur. Also, procedures are given for cleaning the drive and making minor adjustments.

Removing the Cover

To see the parts in the disk drive the outer shell must be removed. To do this turn the drive on its back and remove the four Phillips head screws. Store them in a place where they can be found again! To remove the cover, carefully turn the drive face up and slide the cover toward the back of the drive (the power is off!! Right?).



Be sure the disk drive cable doesn't bind up between the top and back plate. The cable is set into a small notch in the back plate and should be kept in that notch as the cover is removed.



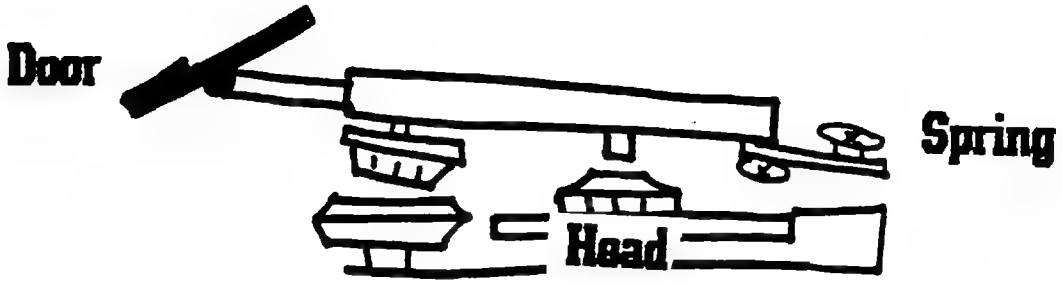
Once the top is off, set it aside and put the disk drive back on its rubber feet.

Parts of the Disk drive:

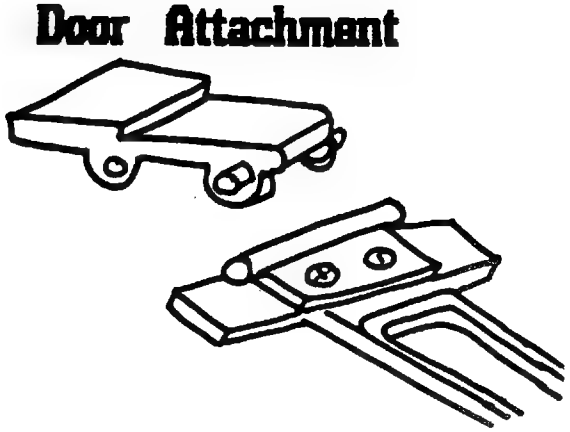
1. Door. Observe the insides of the drive without a disk in it. When the door is closed, it brings a metal support down toward the disk. On this metal frame is a small plastic spindle which presses down on a metal shaft. When a disk is in the drive, these two parts lock onto the disk and turn it.

   Closing the door also releases a small arm which has a small felt button at its end. This felt tip presses against the read/write head. The head looks like a plastic eye with a small black slit.

   Open the door and put a disk in the drive. Open and close the disk drive door and notice what it does. First, it closes the front of the drive and seats the diskette in the drive. Springs on the inside of the door press the disk into place. When the door is open the felt tip on the arm doesn't touch the disk. Close the door. The felt now applies pressure on the disk forcing it against the head. This button keeps the disk in contact with the head to help transfer information.



** Suggestions: Occasionally the little arms on the door which slide in the frame break and the door needs to be replaced. To avoid breaking them, lift the door to its open position with your fingers rather than letting it snap up. Also, if the door won't close avoid forcing it. Check to see if the disk is properly seated in its tracks.



A major debate rivaling the "chicken or the egg" controversy is whether the disk drive door should be left up or down when the system is not in use. What we need to consider is damage to the little cat eye, or read/write head! If it is scratched then life ceases until it is replaced. If the drive door is up then nothing touches the head except dirty air. If the door is down, the head is covered with the felt tip to keep it warm. In both situations there is little chance of damage. If you plan to transport your computer I would close the door to keep the metal frame from bouncing around.

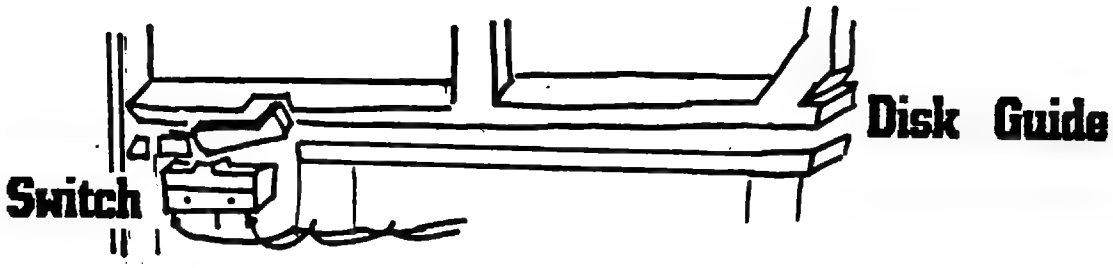
Will a disk in a drive with the door open and the drive motor running damage anything? If the door is up the spindle above the center of the disk hasn't clamped the disk. Thus, the disk won't spin. Also, the arm holding the felt tip is up and not touching the disk and the disk, in turn, is not touching the read/write head. Not much chance for problems but your electric bill might go up a penny if you leave the motor running for a week.

2. <u>"In Use" Light</u>. This light indicates when the disk drive motor is on. The disk drive light comes on <u>before</u> the computer begins to read or write information and stays on for a short time <u>after</u> the computer has finished accessing the disk. This delay is necessary so that the disk drive has time to get the disk spinning at the proper speed before information is transferred.

3. <u>Interface cable</u>. The cable transfers information between the disk drive and computer. Be sure to align the cable and pins properly on the interface card.

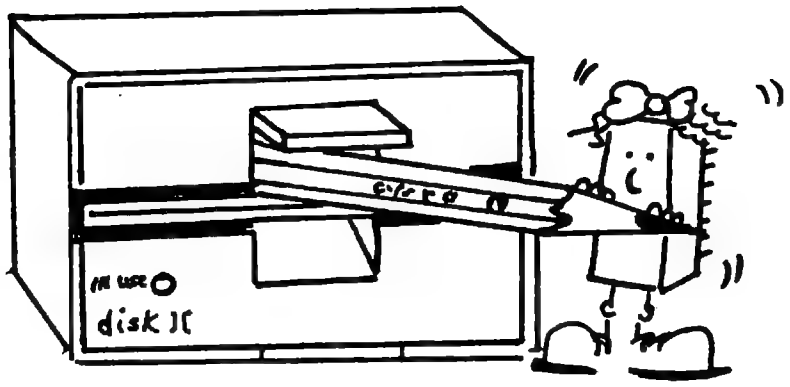
** Suggestions: The cable has caused few problems despite having to bear the weight of dangling disk drives that have slipped off computers. The only problem I have had with the cable is with the clamping device Apple supplied with the new computers. This metal device grips the disk drive cable and then can be secured to one of the openings in the back of the Apple. Sometimes, though, the clamps pinch the wires in the cable causing the drive to malfunction. And I could <u>always</u> count on it to be in the way if disk drives were to be moved. To avoid problems I install the clamps in a recycling bin or throw them at stray dogs.

4. Disk guide slots. Slide a disk in and out of the disk drive and observe the guide slots on the disk drive sides that hold the disk in place.



** Suggestions: Sometimes disks manage to twist their way out of the guides and jam inside the drive. It is a challenge to get the little bugger back in the grove. If the computer Gods insist on keeping your disk crinkled inside the drive, try these tactics:

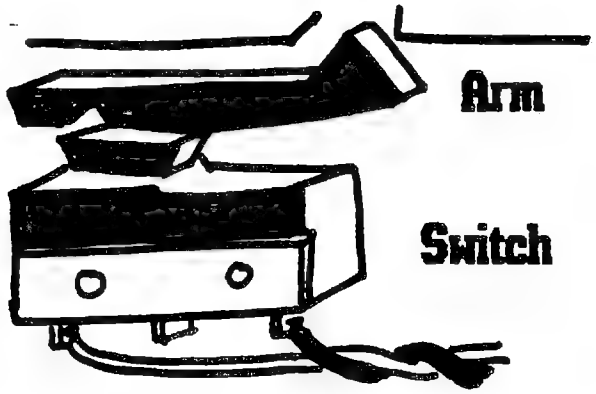
a. Open the lid and poke your finger in above the disk and to the side(s) that appear to be out of line. Try to press the edge of the diskette back into place. You can also use a pen or pencil as long as contact is not made with any objects in the area of the shinny oval on the diskette. These methods usually solve the problem.



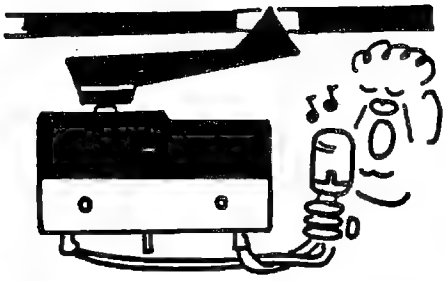
b. But if it doesn't, you can always remove the lid of the drive and work the disk back into position. With the lid out of the way it is an easy matter to get pudgy fingers inside.

5. Write protect switch assembly. Remove the disk from the drive and look for a gap in the left guide slot (the "in use" light side). An arm with a point on

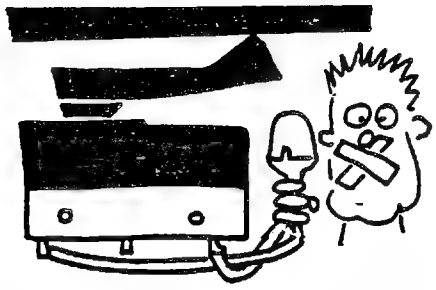
the end that extends into this gap is attached to the frame of the drive. Just below the arm is a small switch. Two wires extend from the switch and run to the back of the drive. This is the write protect switch assembly.



Slowly insert a disk into the drive until it makes contact with the point of the write protect arm. Push the disk past the arm and listen for a "click" as the arm is forced down. This switch, when depressed, prevents writing on the disk. Slowly insert the disk until the write protect notch (the small notch on the left edge of most disks) is above the switch. Again, you should hear the "click" as the arm of the switch pops into the hole provided by the disk notch. Once the disk is in place and the arm is in the notch, information can be written to the disk. (Note: the system master does not have a notch. Use a standard disk with a notch for this demonstration.)



Unprotected

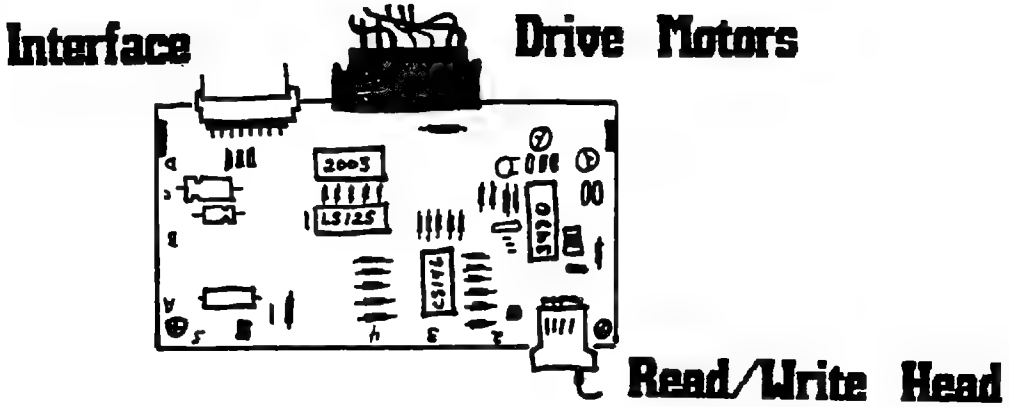


Protected

** Suggestions: To protect software from accidental erasures, put tape or a write protect tab over the notch to keep the switch depressed.

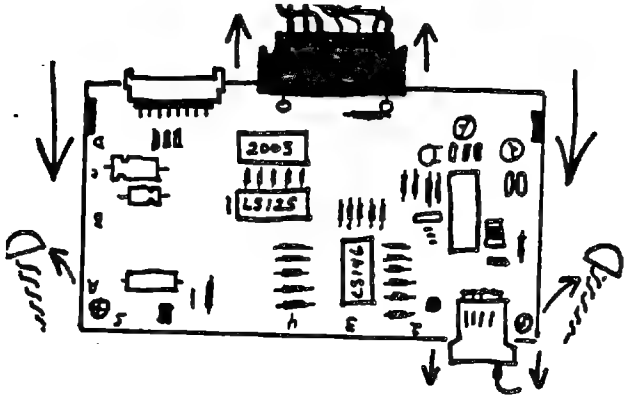
DOUBLE NOTE!!: Tape over the notch does not guarantee that the disk is safe if the disk drive is malfunctioning. Never use a valuable disk in a drive of questionable scruples! They seem to find ways of breaking the rules and erasing parts of disks.

6. Analog card. The printed circuit board on the top of the disk drive is called the analog card. The card, along with the interface card in the computer, work to transfer information between the computer and the storage disk. The analog card is held to the frame with two phillips head screws. Three plug-ins are attached to the card: one from the read/write head; one large black connector from the disk drive motors and a small circuit board in the back of the drive; and the interface cable from the computer.

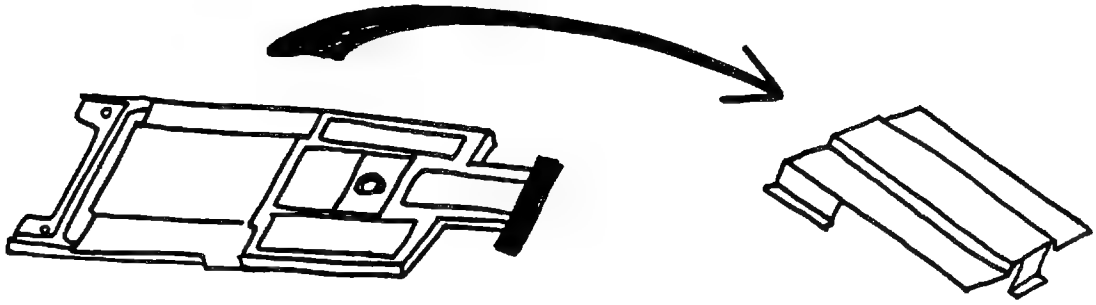


** Suggestions: Chip pushing can be done with the four black chips on the card. The major concern with disk drives is preventing damage to these chips. Often, some of these chips are destroyed when the interface cable is improperly connected to the interface card in the computer (see chapter III) The LS125 is the first to go. See chapter IX for a description of chip testing, removal, and replacement.

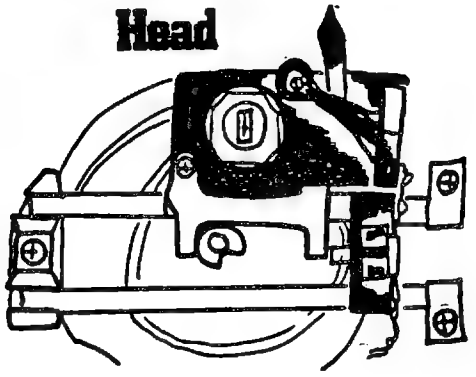
7. Shield- Removing the Analog Card. To better see the read/write head remove the phillips head screws from the analog card and disconnect the three cables. The large cable at the back of the card has four little fingers which snap into small holes on the card. Gently user your fingernail or a small flat blade screwdriver to ease the fingers out of the holes and then work the cable off the connectors. Once the cables are removed, gently pull the card toward the front of the disk drive until it clears the grooves in the back of the drive.



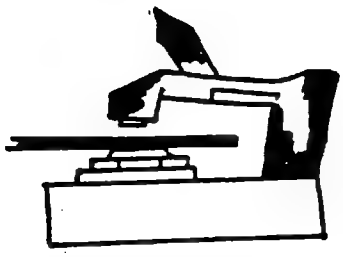
Below the card is a metal shield that snaps onto the arm connected to the door. Remove this plate.



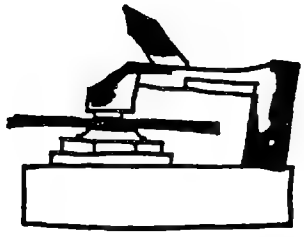
8. Read/Write Head. The head is near the center of the disk drive and is built into an assembly which rides on two metal rails. Carefully lift the small arm just above the head to get a better view. Be careful not to touch the felt tip with your greasy hands!



The center of the head is usually white with a small black slit. This slit is the "eye" that reads information to and from the disk. Carefully slide a disk into the drive and leave the door open. Now, take a side view and note that the opening of the disk is directly over the head, though it may not be touching it. Now close the lid. The felt tipped arm is lowered onto the disk, forcing it against the head. Only when this pressure is applied will the disk drive transfer information.



Non-transfer

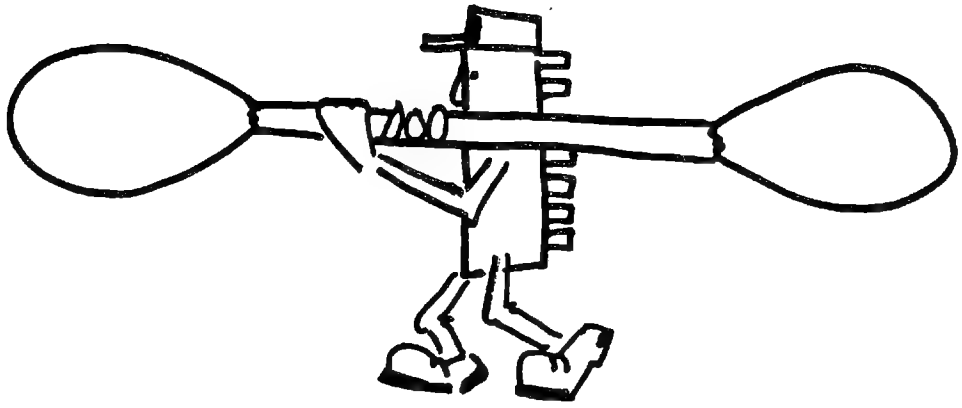


Transfer

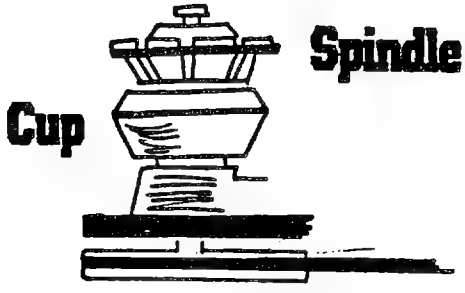
9. Cam. Remove the disk. Using a clean finger or the wooden end of a cotton swab push the the head assembly either forward or back. This is what head does when it searches for information on the disk. As you can see it only moves about an inch. Note just below the head assembly is a plate with a spiral groove in it. It looks like someone took a knife to it and lopped off a section of what otherwise would have been a nicely shaped disk. As you push the head over the plate, a small metal finger from the head assembly pops in and out of the groove making quiet clicking sounds. Normally, the little metal finger rides in that groove and as the plate (or cam, see below) turns, the head moves.

**Suggestions: Cleaning the head doesn't hurt, though I have never had it solve a problem. Kits for cleaning drives are available and include special disks with felt innards and a cleaning solution. After soaking the felt with the solution, the disk is inserted in the drive and the computer turned on. The felt rubs against the head, cleaning it. All of these features are yours for about $25.

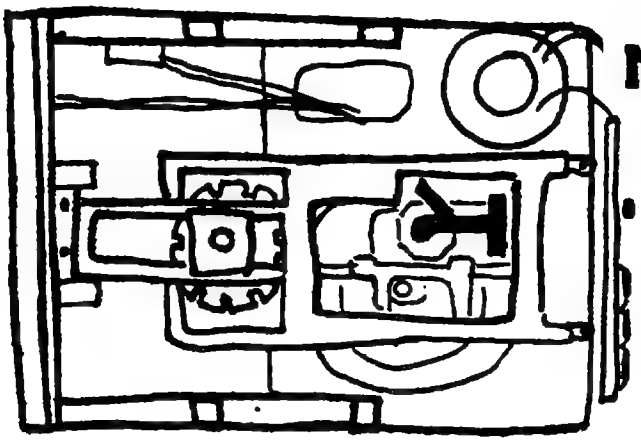
A cheaper option for the standard Apple disk drive is to purchase a small bottle of cassette head cleaner and a bunch of 6-8 inch long wooden cotton swabs or special foam tipped swabs. Soak the swab and then rub it across the head. Cost: about $5.00 for the "kit". The cleaner also comes in handy for sprucing up the metal rails the head assembly slides on. Sometimes dirt and grease get on the rails and gum up the slides. Soak the swab with solution and run it along the rails. Slide the head assembly out of the way to clean the full length of the rails.



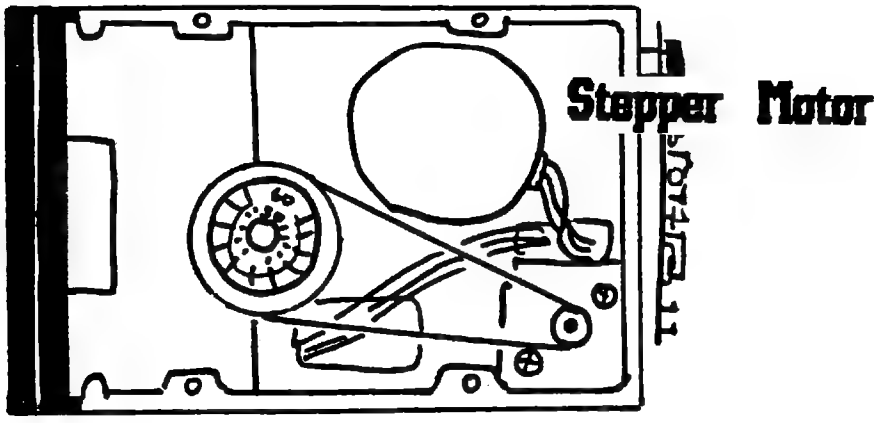
10. Disk rotation motor and assembly. Remove the disk from the drive. Near the center of the drive is a metal cup attached to a shaft running into the housing. Insert the disk in the drive and note that the center of the disk is almost directly over the cup. Close the drive door. The spindle clamps down and centers the disk on the cup.



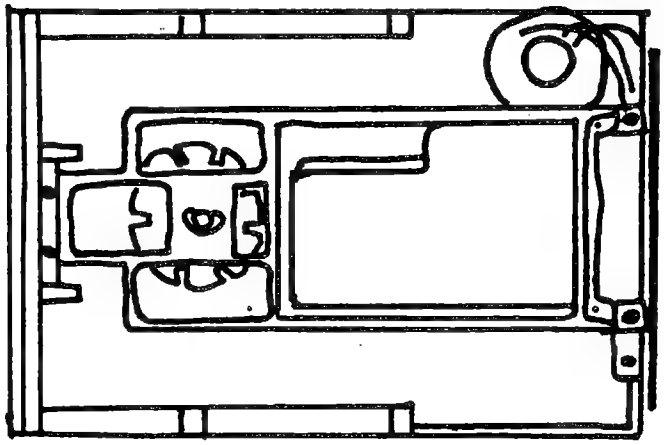
A small motor is located at the back of the drive. It extends through the housing under the drive and is attached by a belt to the shaft that turns the disk.



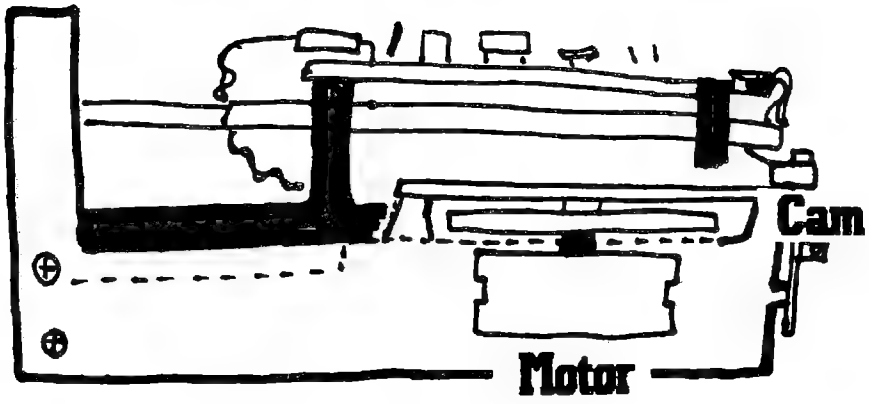
Optional: To see the pulleys and the stepper motor, place the drive on its side. Take out the four screws on the bottom of the drive and remove the bottom plate so you can see inside the casing. Note that the interface cable is still attached to this bottom plate. Inside you can see the pulley from the small motor and the large pulley connected to the shaft that turns the disk. This motor turns the disk at a constant rate of about 300 revolutions per minute.



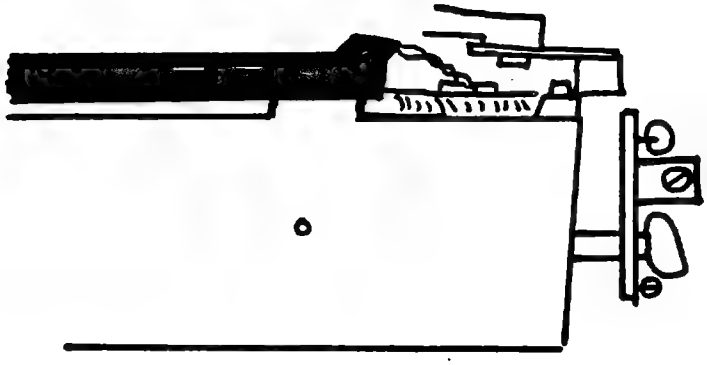
** Suggestions: If you can hear the motor running but the shaft isn't turning, check to see if the belt from the motor to the shaft pulley came off (see "Optional" above to get the bottom cover off). If the shaft turns but the disk doesn't when the door is closed, check the hub. Sometimes (only once for me) the spindle falls off when its retainer comes loose. Shake the parts out of the drive and reassemble the pieces!



11. Stepper motor and cam. Another motor, hidden under the housing, is attached to the plate or cam which has the spiral groove. It is called a stepper motor because it moves the cam in "steps" dictated by the computer. As the motor steps it moves the head to a designated track on the disk (see chapter VII for more information on tracks).



10. Speed adjust screw. The speed adjustment screw is located on the card at the rear of the disk drive.

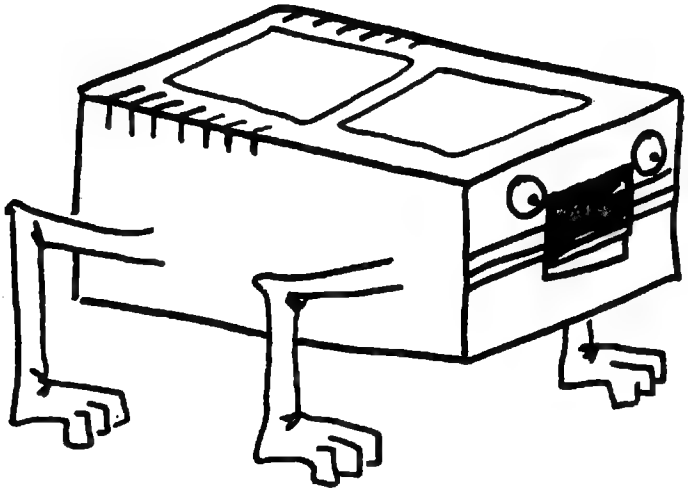


Adjustment Screw

The screw can be turned to vary the speed at which the disk turns. See chapter VIII for a description of this adjustment.

These are the major parts of the disk drive system. All single drive units made by Apple are of this design. Now that you know what the pieces are, it is time to see how these parts function.

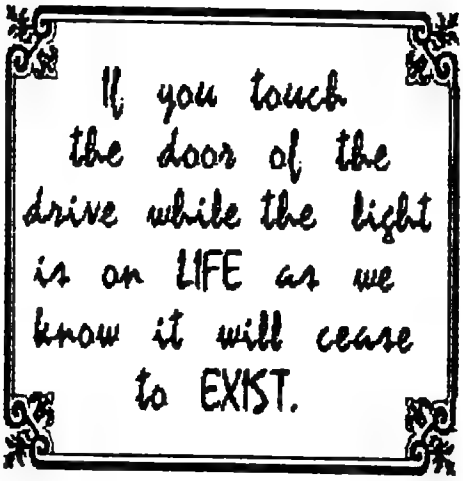
Reinstall the bottom cover, the metal shield over the drive head, and the analog card). If your next mission is to move on to chapter VII leave the top off. Otherwise, slide the top cover back on from the rear with the grill work toward the back. Be sure the cable is in the notch of the back plate as you slide the cover on. Finally, reinsert the screws.

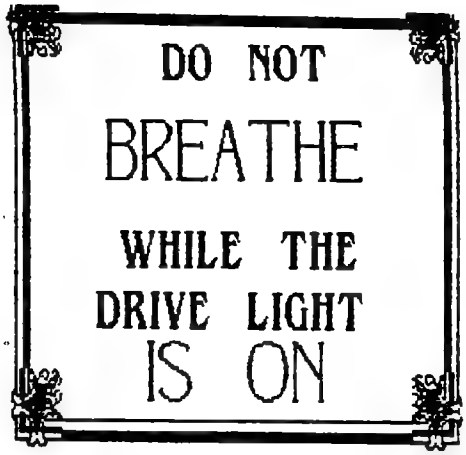


Move To Chapter Seven

Chapter VII. HOW DRIVES AND DISKS WORK

I remember clearly one school I visited three years ago to diagnose a disk drive that wasn't working. It was during the second year of our district computer education program and people were enthusiastically following the rules about disk and computer handling. One of these rules was, "Do not remove the disk when the red 'IN USE' light is on." Signs like these were usually pasted around the computer area:





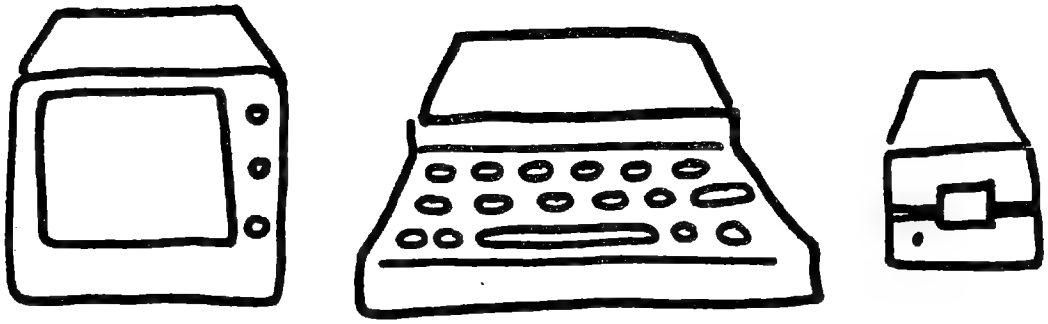
As the district computer coordinator I had been called to check out the disk problem. As the teacher sat next to me I quickly went through a series of checks of the system. But just as I was about to take a disk out and put another in the teacher sharply slapped me on my offending hand (the one about to open the drive door) and told me not to remove the disk when the "IN USE" light was on! Yes, the light was on and ,yes, I was in near shock!

In the early years of educational computing myths about computers were rampant. Many of these were turned into rules which still live in the hearts of cautious computer users. "Turn on the monitor before the computer", or was it the other way around?? "Insert the disk and close the lid twice." "Never write on the disk label with a pen or pencil." "Do not whistle while the disk drive light is on!" With a little knowledge about how computers work you can separate the wit from the gaff.

The disk drive and the disks used in them are the major source of problems for computer systems. In order to cope with these irritations, it helps to have a working knowledge of how the computer stores and retrieves information on a

disk and, in a more practical sense, what mechanical movements and sounds accompany these actions. Armed with this information, it is much easier to corner a problem in the system and resolve it. This chapter will provide that information.

The minimum system needed for the activities in this chapter is a computer with a disk drive in slot six and a monitor. Remove the cover from the disk drive as described in the first part of chapter VI. Double check all connections in your system then insert the system master and turn on the system to be sure all is functioning properly. If results are positive, continue on.



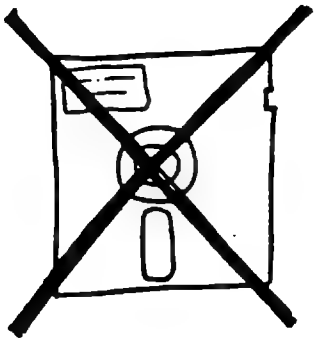
Monitor Computer Drive

Other supplies needed are:

1. A system master or other disk with standard DOS.
2. A disk that can be erased.
3. A write protect tab. The tabs are those rectangular shaped pieces of tape for putting over the notch of the disk. They usually come with a box of disks.
4. A phillips screwdriver.

To help understand what is happening in the computer, a number of activities are described for you to do. In addition to observing the action of the drive you also need to listen carefully to the sounds it makes. It might be necessary to repeat some of the exercises if the dog happens to bark at the wrong time.

*** Experiment 1 ***



Description:: The disk-less system

What is the computer system without a disk? Some commands are built into the computer's memory. The booting of a disk adds to this command list to give you more flexibility.

Procedure

1. Remove the disk from the disk drive and turn on the system. The drive will continue to spin until you do the next step.

2. Press the control-reset keys to stop the drive.

3. Type the following commands and note the response of the computer. Be sure to press the RETURN key after each line. Press control and reset to unfreeze the system only on examples d and i.

COMMAND	RESPONSE
a. CATALOG	_____
b. 10 PRINT "HELLO"	_____
c. SAVE PROGRAM	_____
d. LOAD PROGRAM	_____
e. LIST	_____
f. RENAME PROGRAM, HI	_____
g. LOCK HI	_____
h. RUN	_____
i. PR#6	_____

Analysis

Without the disk, the computer responds quite differently than expected. The above commands separate into two groups- those that function properly without the aid of having used a disk to start the system and those that cause errors or bizarre silence and beeps:

WORK OK	PROBLEM COMMANDS
10 PRINT "HELLO"	CATALOG
LIST	SAVE PROGRAM
RUN	LOAD PROGRAM
PR#6	RENAME PROGRAM,HI
	LOCK HI

The first group consist of commands or statements which are known by the computer. These commands reside in the "permanent" memory of the Apple (i.e., the ROM chips). For example the PRINT statement is a part of the Applesoft BASIC programming language of the Apple. LIST and RUN are commands built into the computer for working with BASIC.

The second group of commands, though, are not a part of the computer. They are commands that are added to the computer's vocabulary when a disk is booted (i.e., turning the system on and reading information from the disk in the drive). In addition, many other details are transferred from the disk to the computer during the boot process.

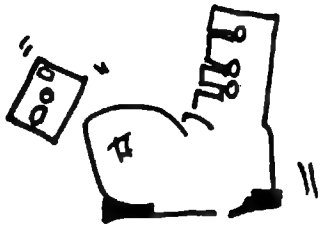
By the way, the SAVE PROGRAM and LOAD PROGRAM did not generate a SYNTAX ERROR response from the computer as did the other commands. This is because SAVE and LOAD are not foreign commands to the computer. These two are used for saving and loading programs with cassette tape!

In the good old days of cassette storage, one would push the RECORD buttons on the tape recorder and then type SAVE and press return. The computer would then send about a 10 second lead to the tape that, when played back through the tape recorder speaker, would sound like the wail heard on the radio during those emergency broadcasting tests. Then, along would come the beep (remember the beep??), followed by the program, and then another beep to signify the end of transmission. The LOAD command is similar, except, of course, the computer has a tough time finding a program on tape, let alone a tape recorder!

*** Experiment 2 ***

Description: Booting a disk

What steps does the disk drive go through during the boot process? Usually noisy clatter, swishing sounds, and a lot of vibration emanate from the drive. Observe closely what happens in this exercise and repeat the process a number of times. Read chapter VI for background information.

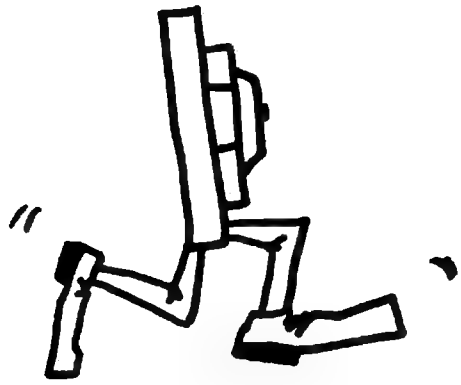


Procedure

1. Put the system master disk in the drive and close the lid.

2. Turn on the computer and observe the physical functioning of the disk and the disk drive. Identify these phases in booting:

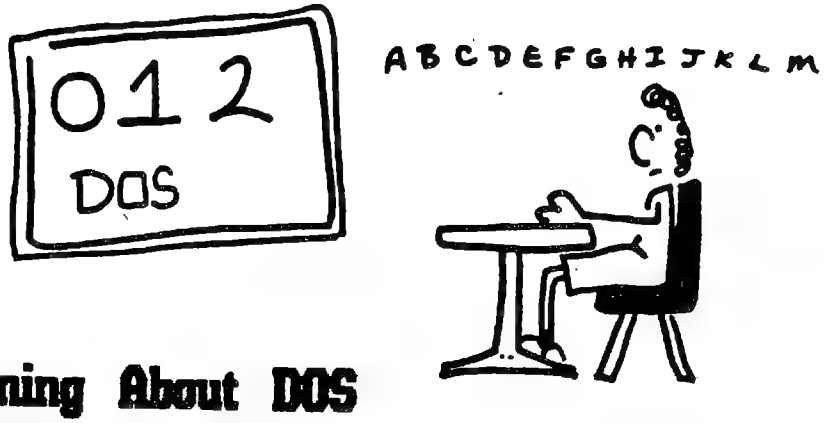
   a. Warm up. The disk drive disk motor turns on and the disk begins to spin. At the same time the cam turns, forcing the head to the outer edge of the disk (toward the back of the drive). Sometimes there will be a rattling sound if the head is already partially retracted.



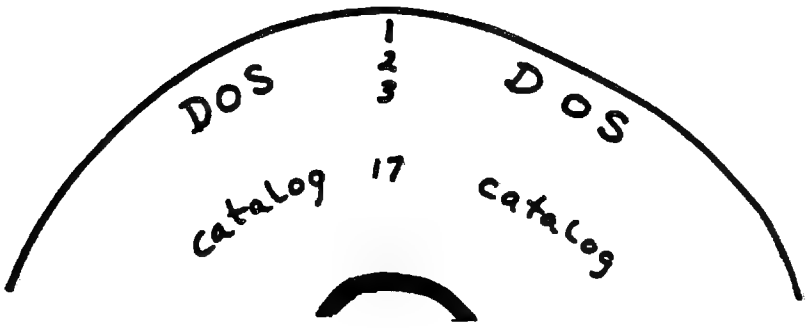
Race To The Outer Edge

   b. DOS loading. In this stage the head finds information on the outer three tracks (0,1 and 2). There are 35 concentric tracks on the disk where information is stored as described later in this chapter. If you watch closely you will see the head make three small adjustments as it moves to the three tracks. This is where it learns what commands such as CATALOG, LOCK, and RENAME "mean" as well as many other terms. Information on these three tracks

tell the computer how to use the disk drive. This information is known as the disk operation system or DOS for short (rhymes with "boss").



c. Find first program. After loading information from the outer track, the head will make a relatively long slide to the center of the disk access oval. This causes the familiar "swish" sound as the cam rotates to bring the head to track 17 (near the center of the disk tracks). This is where the "CATALOG" of all the files on the disk are stored. It will pause here for a moment as it looks in the catalog for the name and location of the program that DOS told it to load and run. The catalog tells the computer where to send the head to find this program. Usually this program is named HELLO, as in the case of the system master.

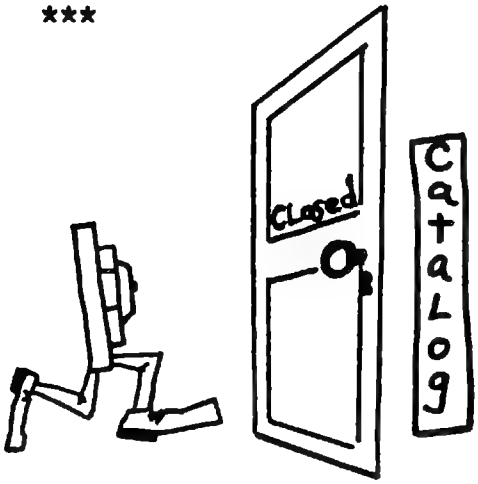


d. Loading first program. Next, the cam will move slightly and pause. The computer loads and runs the first program (HELLO). This program has directions that tell the computer to load another file called "INTBASIC". The head will move back to the catalog track to find this program and then proceed to swish to its location on the disk and load it into the computer's memory.

Analysis

All disks with standard DOS will respond in a similar manner. By observing the disk drive head position, or even just the sounds of the computer you can tell what function the disk drive is doing. Or, in the repair sense, what it isn't doing.

*** Experiment 3 ***



Description. Cataloging a Disk

The catalog track of the disk stores information about the files stored on a disk. Some of this data is displayed when a "CATALOG" of the disk is executed. The screen will display the type of file (Applesoft, Integer, Binary, etc.), how long it is, the name of the file, and whether it is write protected. The catalog also stores a record of where on the disk all of the files are located. When the computer needs to load a file into the computer it must first find its location on the disk from the catalog. This experiment demonstrates how the head moves to the catalog and what happens if it is interrupted in task.

Procedure

1. Insert the system master in the drive, close the door and boot the system. Type CATALOG and press the return key. The head should again return to the center of the oval area of the disk. The catalog should be displayed:

```
*A 003 HELLO
*B 003 APPLESOFT
*B 006 LOADER.OBJ0
*B 042 FPBASIC
*B 042 INTBASIC
*A 003 MASTER
*B 009 MASTER CREATE
        .
        .
        .
    (etc.)
```

As mentioned above, four items of information are displayed about a file when the disk is cataloged:

a. The star indicates that the file has been "LOCKED". This Disk Operation System (DOS!!!) command tells the computer that no other information can be stored under that particular file name. See your DOS manual for more information.

b. The letter following the star indicates what type of file is listed. The "A" in front of HELLO marks this as a file written in the (A)pplesoft BASIC language. Files containing binary numbers representing a machine language program, a picture, or data are prefaced with a "B". Other files have a "T" before them, such as those created by some word processors. "I" is used for programs written in (I)nteger BASIC. A few other letters are used for a few exotic file types.

c. The number tells how many storage spaces, or sectors, were used to store the file on the disk.

d. Finally, the name of the file is given.

2. Repeat Step 1 above. This time the disk starts spinning but the head doesn't move. The computer remembers where the head is located and since it just completed a catalog of the disk and is under track 17 it didn't need to move.

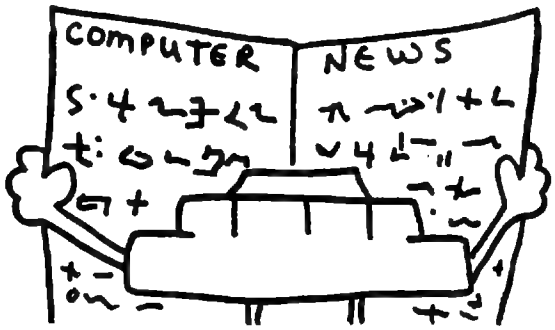
3. Repeat Step 1 above once more but this time, lift the door of the disk drive after it has started to list the catalog. Sudden calamity! There is that horrible clatter of teeth clawing at your disk and ripping out the insides of the drive! The computer beeps,stops running the drive, and displays:

I/O ERROR

Close the door and repeat the step again and observe what the disk drive head is doing. Here is a blow by blow description:

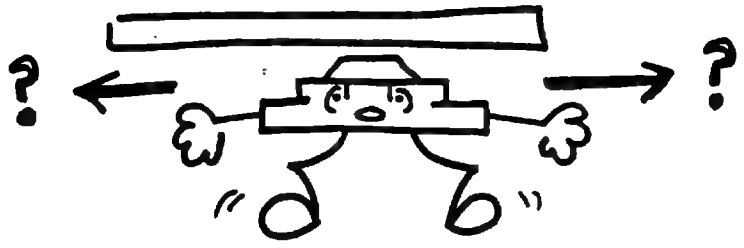
a. (Computer turned on) The head moves to the catalog track (17) and begins reading the information.

b. (Door opens) The head looses contact with the disk and is unable to read the information.



In desperation (if computers could feel desperate this is the time!), the head retracts all the way to the outside track. This is the only track (0) it can physically go to when it is lost. It can't move just a little, read the information on the disk at that point, and discover its current position. It must go all the way to the outside track. The stepper motor backs the head to the outer track in 35 steps, one for each of the tracks. The clattering noise heard in the drive is caused after the head is retracted 17 steps (remember, it was at track 17) yet the stepper motor has 18 more steps to move. Thus, you will see the head assembly bump against the cam stem, causing the noise.

c. Since the door is still up the head is unable to read even the 0 track, so it calls it quits and gives an error message.

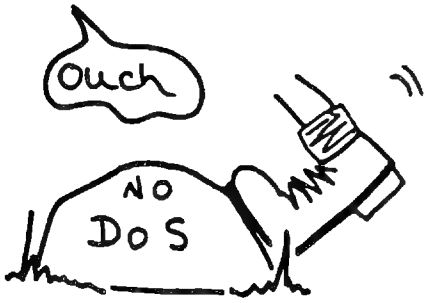


4. Type CATALOG again and lift the door as before. Press the return key and the head begins reading the information from track 17. Lift the door of the drive. When this interruption occurs, the head swings back to 0 to recount out to track 17. This time, close the drive door after the clatter. The head is able to "find itself" so to speak and moves to the proper track and catalogs the disk.

Analysis

Anytime the disk can't find the information it is looking for on a disk, it will reset back to the 0 position. If it finds the 0 track it will again count steps back to the track it was suppose to be on. If this attempt fails, out comes the familiar "I/O ERROR" on the screen.

*** Experiment 4 ***



Description: Blank Disk Boot

What happens if a blank disk is used as the boot disk? The test will demonstrate how a drive will respond to a blank disk.

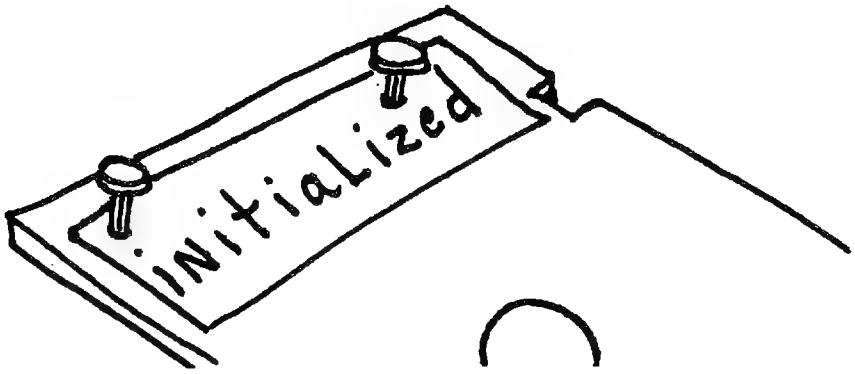
Procedure

1. Insert your blank disk and turn on the computer. Observe the head movement. Where does it stop? What is the drive trying to do?

2. Press control-reset. Type CATALOG and press return. What happens? does the disk drive head move? Is the Disk Operation System loaded in the computer?

Analysis

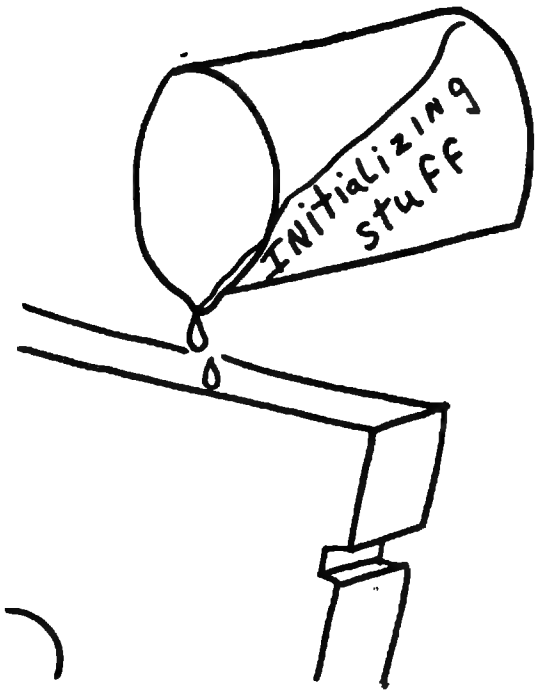
A blank disk is like a post office before the sorting sacks and post office boxes have been installed and labeled. A blank disk has no marked storage locations on the disk or even the DOS and so the head searches in vain for information on the disk passing overhead. To make storage cells on the disk that the computer can find and use the disk must be "initialized".



*** Experiment 5 ***

Description: Initializing a Disk

The process of initializing a disk involves a number of jobs that must be completed by the disk drive in conjunction with the directions from the computer. Most of these are easily recognized by observing the motion of the read/write head during initilization. In order for the computer to initialize a disk it must first "learn" how to do it. Then all the directions for DOS must be transferred to the blank disk. Once initialized, the new disk can then load the Disk Operating System into a computer on its own. A description of the initialization process is described in the Analysis after this exercise.



1. Insert the system master disk and turn on the system. Listen to the drive and notice the head movement as it loads the DOS into the computer and runs the HELLO program. One of the DOS commands it loads is the INIT command.

2. A short program needs to be written to be included on the new disk as the HELLO program. Type the following and press then return key after each line:

```
NEW                                (clears memory)
10 HOME                            (clears screen)
20 PRINT "THIS DISK IS MINE"
30 END
```

3. Insert a blank disk. Type INIT HELLO, press the return key, and listen and observe the actions of the disk drive. These exciting events should occur:

   a. A clatter as the head resets to the 0 location.

   b. Marking off tracks and sectors on the disk is easy to recognize (see the analysis of this experiment for more information). The head

makes about 35 small swishes as it proceeds to label each of the tracks and their sectors on the disk. It slowly works from the 0 track on the outside edge to the inner most track, 34.

c. Now that the tracks and sectors are labeled the head slides back to the 0 track to store DOS. The DOS, which was loaded into the computer's memory from the disk in step 1 above, is now saved on tracks 0, 1, and 2. Listen for the swishing sounds as the head marks the tracks and then moves to the outer edge of the disk.

d. The head moves to the catalog track (17), stores the name and location on the disk of the file it is to find when this new disk is used to boot a computer. This name is usually HELLO and is the file name that follows the INIT command. Any other name could be used. If you wanted to type "INIT RUBBER DUCKY" the program written in step 2 would be saved as "RUBBER DUCKY" on the disk and would be the first program loaded after the computer finds DOS.

e. Finally the head moves to a track to store the HELLO (or RUBBER DUCKY) program.

f. The disk drive stops spinning and control returns to the user.

4. Reboot the system (turn off the computer or press control-open apple-reset) with the new disk and observe the disk drive.

Analysis

To initialize a disk, the computer must "mark" storage spots on the disk. The disk is made up of a thin sheet of plastic which is coated with iron oxide on both sides and then a thin protective coating over that material. An abbreviated description of different types of disks is usually listed on the box or disk. They are:

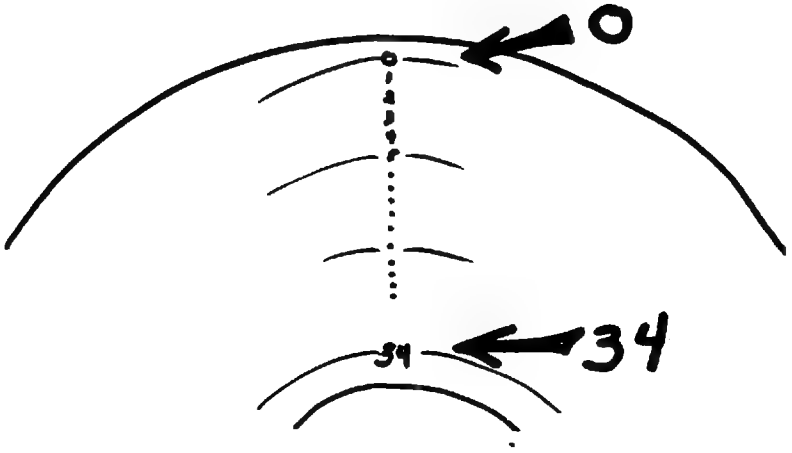
abbr.	meaning
SSSD	Single Sided, Single Density
SSDD	Single Sided, Double Density
DSSD	Double Sided, Single Density
DSDD	Double Sided, Double Density

The "side" is referring to whether one or both sides have been certified as good. Single sided disks

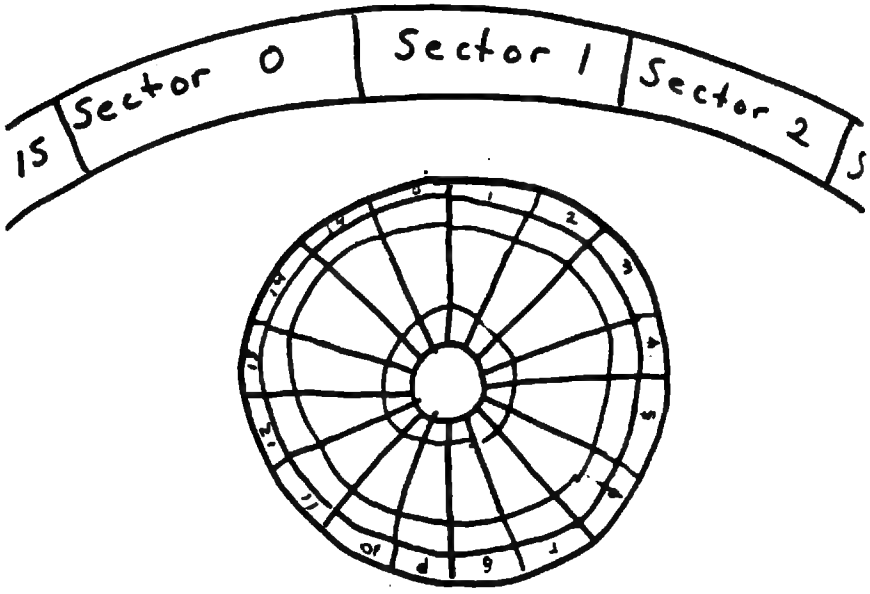
have been check on only one side. Double sided disks have a seal of approval for both. The back side of a single sided disk can be used, but it may have a defect since it hasn't been certified.

The density of the disk refers to the quantity of material on the disk for recording information. The double density disks are a better quality and can store more information. The Apple computer drive works fine with single density disks, but the double density might be a plus for applications requiring a great deal of disk access and accuracy.

When you first purchase a rust coated disk, it is blank as far as the computer is concerned. So, before the computer can make use of the disk it must mark off circular tracks on the disk and number them for easy reference. The tracks are numbered from 0 on the outer ring to 34 on the inner most ring.



Then, each track is broken up into other storage cells called sectors. These are given numbers 0 to 15 for reference.



Each sector can hold 256 bytes or symbols (characters, digits, keyboard symbols). So how much memory is on a disk for you to use?

Tracks---------->	35
Each track has 16 sectors---->	X 16
Total sectors----->	560
Each sector stores 256 characters---->	X 256
Total charters---->	143,360

Sounds like a lot of room, but relative to other storage on other computer systems it is only a couple of squirts in the bucket. Not only that, the DOS is stored on tracks 0,1 and 2 and the catalog is on 17 so those tracks are not available in most cases.

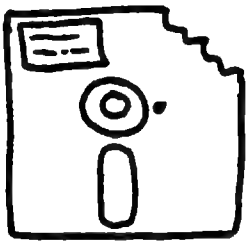
Some disks are specially initialized so that more tracks are available for storage. An example would be most data disks created by word processing programs. If the data disk is only used for storing text from the word processor, there is no need to have DOS on the disk since Dos will have already been loaded into the computer's memory from the word processing program. To test this fact, boot a word processing package (Applewriter IIe, in this example), insert a blank disk, and intialize it (control O, Option G. Initialize a Disk, S6,D1). After the task is done, reboot the computer with the data disk. In most cases, the computer will jump into machine language (the cursor is preceded with a *) and no DOS is loaded.

I have been using the word "boot" as in "booting the system" without clearly explaining the term. When the computer is first turned on it immediately looks to the disk drive for information. As we have noted from previous experiments, when this operation is interrupted with a control-reset your computer system is less than complete. The disk drive is essentially ignored by the computer. The computer is "on" but is not booted. Booting the system means to load DOS into the computer so that your system can communicate with the disk drive.

*** Experiment 6 ***

Description: Faulty initialized disks

Sometimes, the DOS on a disk is damaged or erased. This procedure will demonstrate what happens in that situation.



Procedure

1. Initialize a disk as above but lift the lid just after it slides out to track 0 to store the DOS, but before it moves to the catalog track.

2. Reboot the disk and observe the result.

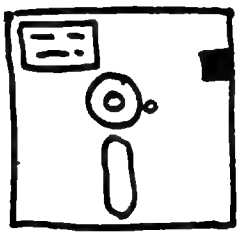
Analysis

The disk drive finds and begins reading information from track 0, but then does not find the DOS in good shape and runs off to error land. Depending on when you lifted the lid of the disk drive the screen will display a star (machine language), "I/O ERROR", or "FILE NOT FOUND".

*** Experiment 7 ***

Description: Write Protect Test

The notch on the side of the standard disk allows the write protect switch to deactivate. If the notch is covered, then information can't be written to the disk under normal circumstances.



Procedure

1. Initialize a disk as described above.

2. Tape the write protect notch on the disk.

3. Now, type INIT HELLO again and press the return key. The computer will attempt to write to the disk but, because of the tape, it can't and an error will be displayed.

Analysis

The grand protection scheme for those valuable disks is at hand. Notice that much of the commercial software is write protected or doesn't even have a notch to tape. This is to protect the disk so it won't accidentally be erased or changed.

NOTE: If the disk drive is malfunctioning the covered write protect notch is no guarantee. I have unknowingly had a disk erased by a bad disk drive and then proceeded to insert another "valuable" disk only to have it erased. Yes- disk drives can damage disks even if the disk is write protected! Never use a valuable disk to "check" a fanatical drive.

Solving Disk Related Problems

How will this information help in solving problems? Let me give some examples:

PROBLEM 1:

When the computer is booted the disk does begin to spin, but the head does not move. Booting with different disks makes no difference. After sliding the head to the 34th track and rebooting the system, the head remains in place. Question: Where is the problem located- in the disks, the computer, or the disk drive?

SOLUTION:

Under normal conditions the head should slide back and reset at the 0 track even if no disk is present. The problem is not in the disks. By testing the drive on another computer the problem can be isolated to either the computer (unlikely), the disk interface card (more likely), or the drive (the prime suspect).

PROBLEM 2:

When the computer is booted, the drive head resets properly to track 0 but then doesn't move. Where is the problem located?

SOLUTION:

Possibly the disk is not initialized so the computer is unable to find any track at all. Test the disk in another system. If it works then the problem is in the hardware- the drive, interface card or computer. Beware, though, of drives that erase parts of disks. Try using an initialized disk in the bad drive. If it won't boot in a good system after taking a whirl with the rotten drive, then the bad system is erasing information from the disk.

PROBLEM 3:

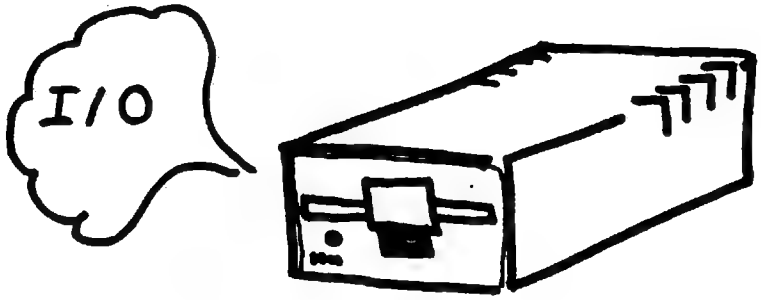
The computer is switched on, the head resets to track 0, and DOS seems to be accessed. Finally, the read/write head moves to the catalog (track 17) shuffles a bit, beeps, and displays a "FILE NOT FOUND" message.

SOLUTION

Type CATALOG. If it works then the DOS is probably loaded properly. Now check the catalog. It seems from the description that all is well with the system and that the only difficulty is that the disk is missing the HELLO program, or a program requested in the HELLO program. This would be a problem with the disk. Try the disk on another computer and see if the same symptoms appear.

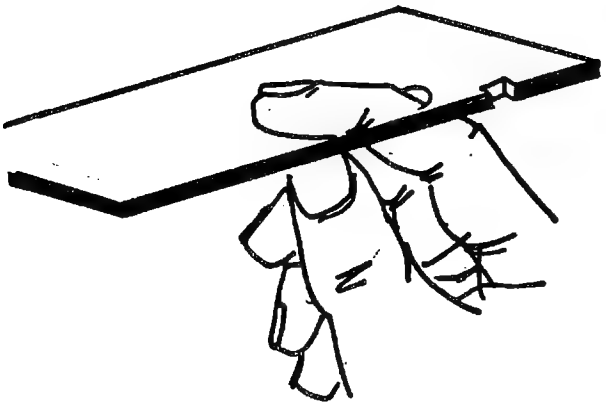
PROBLEM 4:

The drive seems to rattle and clatter a great deal with certain disk. Sometimes I/O errors are encountered and the disk won't boot particular programs.



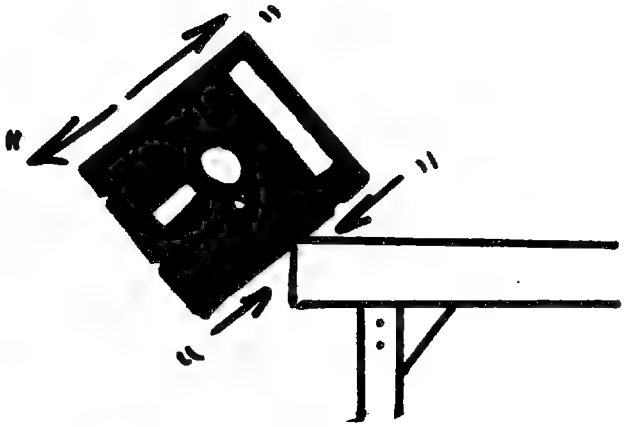
SOLUTION #1

Since only one particular disk is a problem the disk is probably at fault. First, check to be sure the disk turns in the jacket. To do this, put your middle and index finger through the disk hole and hold the inner plastic disk while you try to turn the jacket.



If the plastic doesn't turn easily in the jacket then it definitely will have trouble in the drive. Examine the center ring of the disk for skid marks (shinny areas where the disk has been slipping in the drive). This is another sign of a disk that is pinched in its jacket.

We use to throw these disks away until one of the students in our repair class gave us the solution. The problem is a pinched disk usually caused by having weight on the disk such as in a Pee Chee in the bottom of a locker. Also, too many disks packed into a box will cause pinching. The pressure tends to flatten the protective jacket which in turn puts the disk in a bind. To un-flatten the disk, take each edge of the jacket and carefully scrape it over a corner of a desk or some other sharp cornered object.



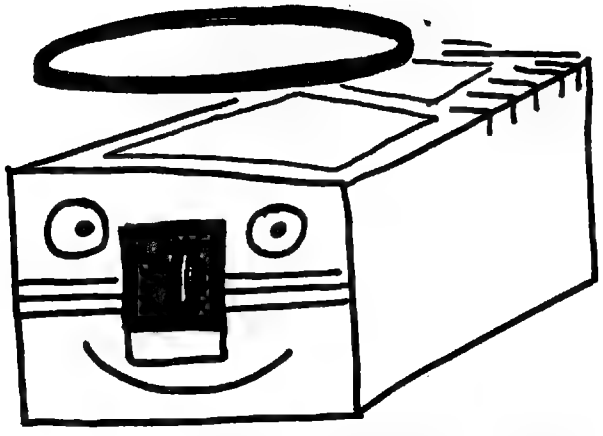
This will fatten up the disk and release the disk for many more hours of contentment in a disk drive.

SOLUTION #2

Visually inspect the disk. Be sure the media used is clean. A student in one of the advanced computer classes brought this to our attention. He had left a half filled cup of strawberry drink sitting on top of his disks in his locker. Or at least it was until he slammed the locker door home. The next morning he brought his sugar coated disks into the computer lab to check for damage. The disks were damaged, and so was a disk drive head when the crystalized sugar sanded it a bit!

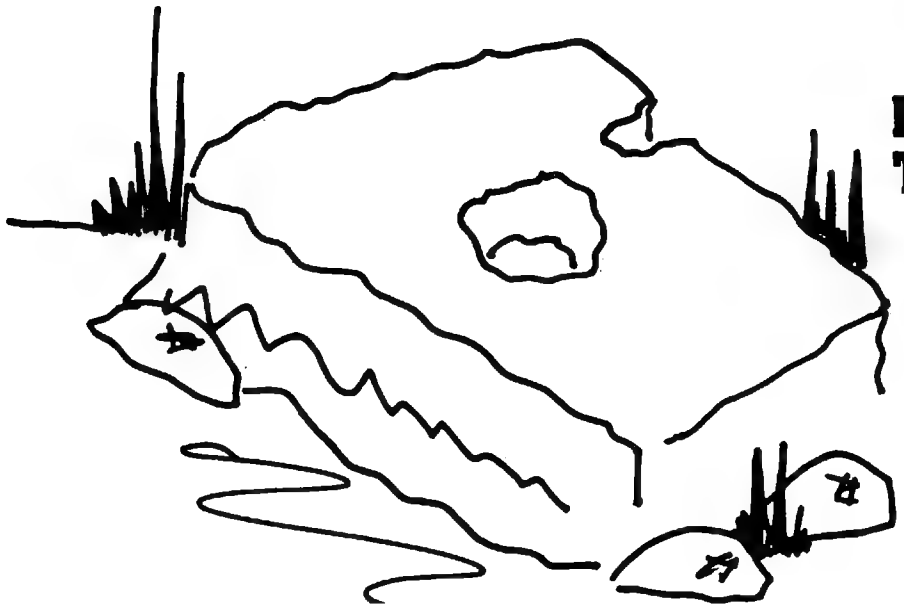
Put your fingers in the center of the disk as described above and rotate the jacket. Examine the side of the disk used by the computer (the side opposite the label). Light reflecting off the plastic in the oval opening makes it easier to see some of the blemishes. A disk which has been bent will sometimes have a crinkle in the disk. Besides sugar crystals, look for pencil or ink marks, punctures, foot prints, and other signs of struggle. Any of these signs send the disk to the storage bin in the sky.

You should now have a much clearer understanding of what all the fuss is about in the computer system when working with disk drives and disks. The more information you have about computers and disks and how they function the easier it will be to understand what is happening when systems are acting like spoiled children and refusing to cooperate.



The Perfect Drive

Chapter VIII: Copying, Disk Speed Test

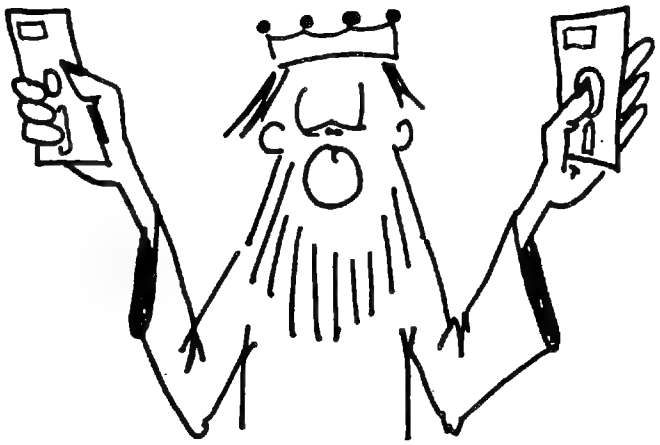


Early Copying Technique

One area of knowledge which is commonly overlooked by many persons working with computers is how to back up disks. People ignore copying because of the time it takes to become proficient, the confusion of sorting through all the different types of copy programs on the market, the expense of purchasing copy programs, and the frustration of having to learn new copy protection procedures. Tons of different copy programs are floating among Apple users and vendors. Each has its own method of copying and, of course, a manual written in some language akin to English. (Some of those folks must not have been able to "back up" a good dictionary program!)

In all this confusion, the Apple gods have sent down from the mountain two excellent copy programs which are on the system master. The programs won't copy protected software but work well for standard disk duplication. These will give us some common ground for discussion.

The root of the problem of "copying" and why most people ignore this important part of working with computers is embedded in our moral upbringing. Didn't you just hate that brat who sat next to you in the sixth grade and <u>copied</u> your spelling test? And who did the teacher accuse of <u>cooooopying</u>???? Evil spies are always copying secret plans for missiles or sewer systems. And what about the computer world? Do you know a bleary eyed hacker who constantly updates you on the dollar value of his pirated game collection? At least its reassuring that computer and software companies would never stoop to copying from each other!!



HAMLET'S HACKERS

To copy or not to copy
That Is The Question

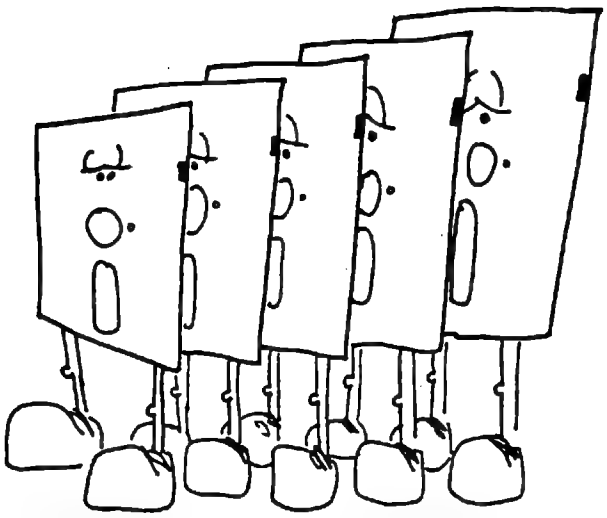
Well, guilt is getting in the way of a legitimate need for protection of your priceless information. This chapter will describe the reasons for copying disks, some of the copying techniques, and why and how to adjust the disk drive speed for copying and proper running of your drive.

You will need to have a system master with the COPYA and FID programs on the disk. This disk is supplied by Apple with each of the computer systems. The computer system, ideally, should consist of a computer, two disk drives in slot 6, and a monitor. These procedures can also be done with a single drive system if you don't mind swapping disks in and out of the drive. Also, a phillips screw driver will be needed for the speed adjust part. A bit copy program, such as Copy II+ (used in our examples), would be useful.

Purpose for Copying Disks

When a program is purchased, such as a word processor, a data base, or a game, the program on that disk has become your property, with some vague restrictions. (These restrictions are constantly being tested and we will leave that up to the legal folks.) If you are hip deep into writing a book and your word processing program fails, much time and energy is expended if you don't have a backup. To protect yourself, make your one legally permitted backup of the program to cope with such emergencies. Without that protection, the software becomes an endangered product. I would never entrust my thoughts to a word processor or data to a data base without a backup. A Peter Principle Extension states:

> *Disks work perfectly when they are not needed*
> *but always fail when you are desperate!*



Backup Your Disks

Almost as important as the main program are the data disks that store the thoughts and ideas created through the program. Have you ever had a dream that you were late for a class, but couldn't remember where it was being held or even if you were taking the class?!! The panic I feel in those dreams approximates the fear I have of loosing information on a data disk. I have a rotational back up system of three sets of disks for my D. B. Master files. All my Applewriter IIe word processing files are backed up on two different disks and I always print out the text just in case both disks go belly up. Some package programs provide a means for doing this, but using a copy program is a quick alternative. Always back up data! Did I say that?? Always back up data! I think I said back up your disks., but just in case, remember to back up your data disks.

As demonstrated in a previous chapter, the DOS on disks can be accidentally erased and catalogs scrambled. Bit copy programs can help reconstruct the DOS or it can be used to copy a good DOS from one disk to another. Some bit copy programs will go through a disk, locate all good (readable) files and reconstruct a working catalog. These programs can be life savers for those who depend on the computer.

TYPES OF COPY PROCEDURES

The three copying techniques commonly used are the file, track, and bit copy procedures. Each have different functions and require a set up specific for that copy procedure. To understand how each of these duplication programs work it helps to have an understanding of files and tracks and how the computer stores and finds information. Chapter VII summarizes this information.

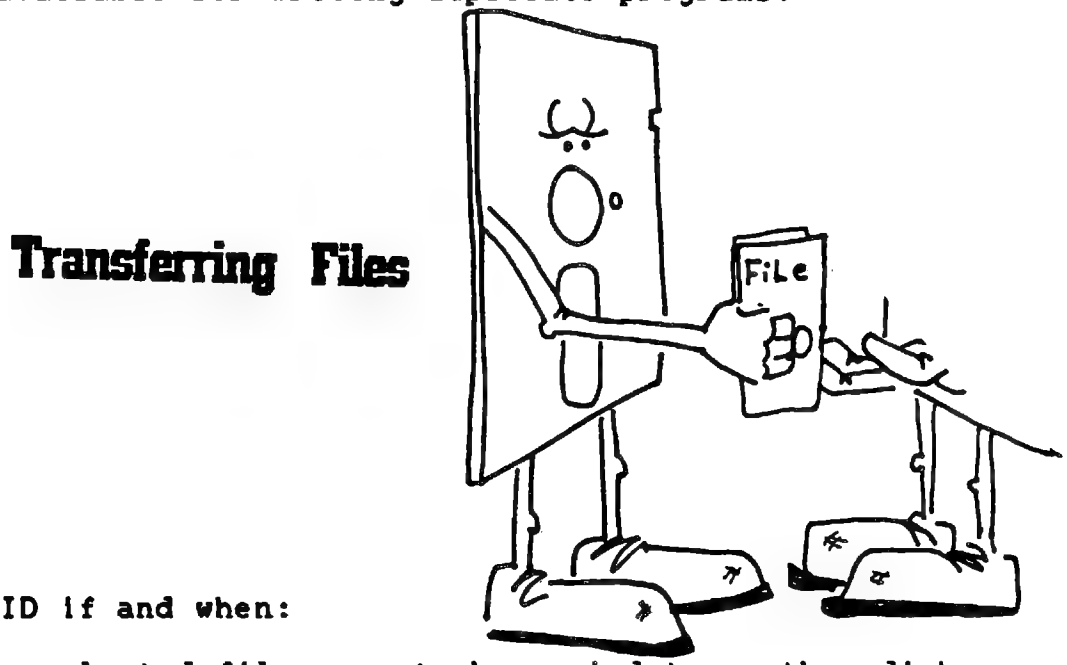
File Copy Programs - FID on the System Master

**** WHEN TO USE ****

This copy procedure is used to transfer selected files from one initialized disk to another initialized disk. It can be used for rearranging programs on disks and for copying programs, especially those prefixed with a "B" in the catalog. Note the "B" in this sample of a cataloged binary file.

B 024 RATGAME BINARY

These binary programs are difficult to transfer from one disk to another but FID does this easily. The key word for FID is file- the program moves files (i.e., programs and data) from one disk to another. It is a file transferring program so it must be able to find the file it is to transfer on the original disk and then be able to save it onto a standard DOS disk. The destination disk must have storage available for writing duplicate programs.



Use FID if and when:

1. Only selected files are to be copied to another disk. (Use COPYA if all files are to be transferred.)
2. The source disk uses standard DOS.
3. The destination disk is initialized. FID does not initialize the destination disk. This must be done by the user or the user must use a previously initialized disk.
4. The destination disk must have room on the disk to store the copies.

**** SETUP ****

This exercise will transfer selected files from the system master to another initialized disk. First, initialize a disk as described in chapter VII and then insert it into drive two. Place the system master in drive one and boot the computer. Type CATALOG and press return. One of the programs listed should be FID. Note that it is prefixed with a "B", so to run it type the following and press the return key:

BRUN FID

After a few seconds the menu should appear.

**** PROCEDURE ****

(The directions for using FID are on pages 184-189 of The DOS Manual published by Apple Inc.) The FID (FIle Developer, according to Apple) has many options, most of which are easy to do. They are:

1. COPY FILES
2. CATALOG
3. SPACE ON DISK
4. UNLOCK FILES
5. LOCK FILES
6. DELETE FILES
7. RESET SLOT & DRIVE
8. VERIFY FILES
9. QUIT

The copy process uses two of the procedures, CATALOG and COPY FILE. Now to transfer files from the system master to the initialized disk in drive two. First, let's transfer the binary program FID to the new disk:

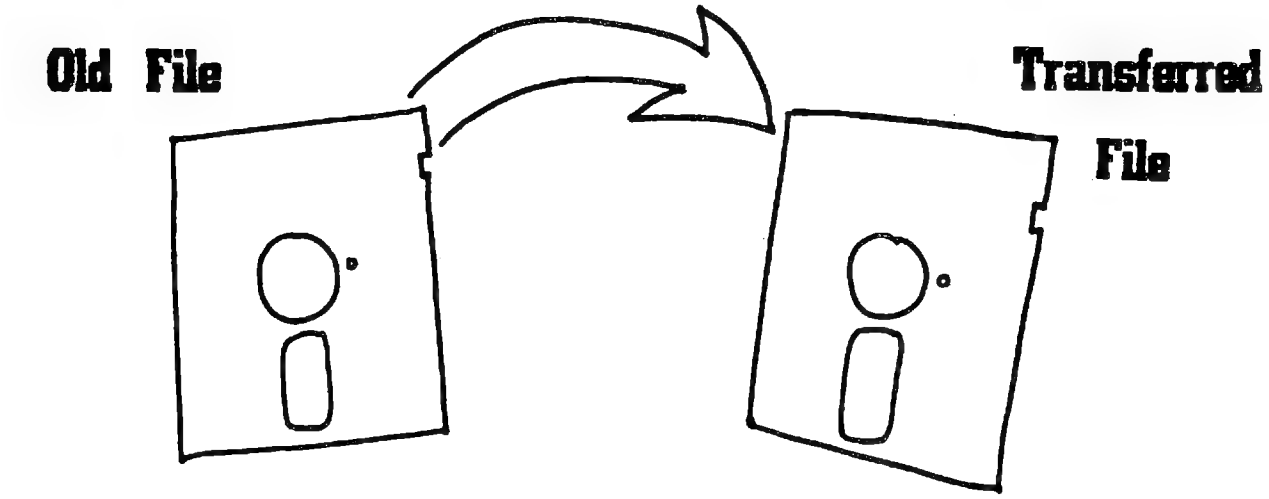
1. Select option 2 (CATALOG) and drive 1 to verify that the file is on the system master.

2. Select option 1 (COPY DISKS).
   a. The source file (FID) is in Slot 6, Drive 1.
   b. The destination file is the new disk in Slot 6, Drive 2. (Use Slot 6, Drive 1 if you are a single drive user.)

```
SOURCE SLOT?6
      DRIVE?1

DESTINATION SLOT?6
           DRIVE?2
```

3. When prompted for the file name type FID and press return. The computer will then transfer the file to the disk in Drive 2. Single drive users will be prompted to insert the proper disk.

```
FILENAME?FID
INSERT DISK(S).  PRESS <ESC> TO RETURN
TO MAIN MENU OR ANY OTHER KEY TO BEGIN
```



4. Select option 2 (CATALOG) and drive 2 to verify the transfer. (Option 2 only for single drive people.)

Now let's transfer all of the files on the system master that have an "A" somewhere in their file name.

1. Do steps 1 and 2 as above.

2. When prompted for the file name type an equal sign (=) which is a wildcard symbol meaning "transfer all files selected".

```
FILENAME?=
```

3. The next question is "DO YOU WANT PROMPTING?" A "NO" would tell the computer to transfer all of the files from the system master to the copy disk. In our case we want to transfer only selected files so respond with a "Y".

```
DO YOU WANT PROMPTING? Y
INSERT DISK(S).  PRESS <ESC> TO RETURN
TO MAIN MENU OR ANY OTHER KEY TO BEGIN
```

4. The computer will read the first file name from the source disk -HELLO- and ask the user if this is to be copied. Respond with "Y".

5. The computer will then read existing file names on the second (destination) disk. Since HELLO is also of the second disk (you created it when you initialized the disk) it will tell you that

```
FILE HELLO
ALREADY EXISTS
TYPE IN A NEW FILE NAME FOR THE COPY OR
<RETURN> TO REPLACE EXISTING FILE OR
<CTRL-C><RETURN> TO CANCEL COPY.
```

   Press control-C and the return key to cancel the copy of that file.

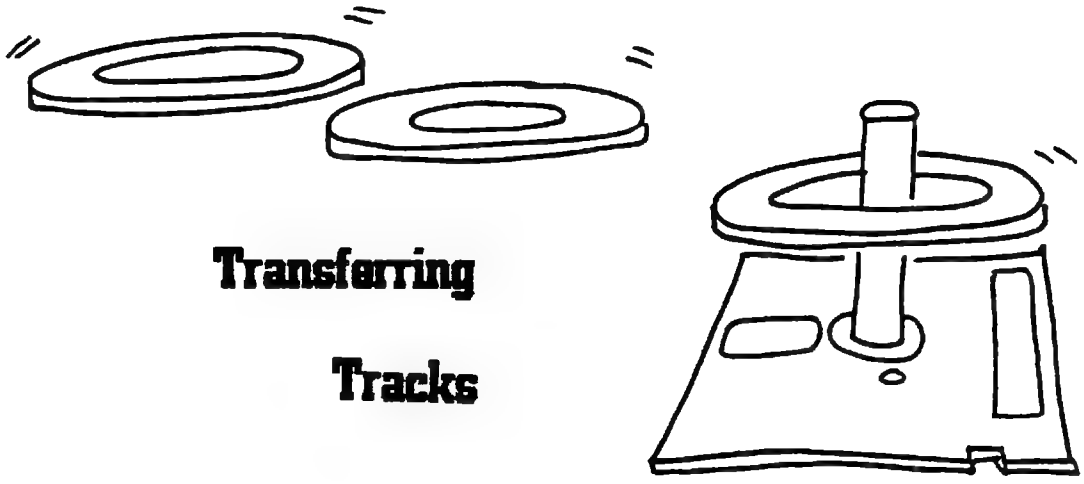
6. Press "Y" for those files you want to transfer and "N" for those to be rejected.

7. When finished press 2 (CATALOG) and select drive 2 to verify that data has been transferred.

Track Copy Programs- COPYA

**** WHEN TO USE ****

This method of copying information does not require an initialized destination disk. The COPYA program on the system master copies the tracks from the original disk and transfers the information track by track. It doesn't look for a file to transfer but rather reads the data on a track and moves it to the corresponding track on the duplicate disk.



The FID program is extremely slow for a number of reasons. The FID program requires you to take the time to initialize the destination disk. Then the duplication program must find each file on the source disk and search for a place on the destination disk to stuff the data. All of his chasing around on the plastic takes time and

patience. Thus, the program spends a good deal of time looking for files and asking you to make decisions about what to do with each.

If the total contents of the disk are to be copied, the COPYA program will accomplish this task much quicker than FID because it transfers information track by track and doesn't waste time searching for files. Note, though, that it can only be used with standard DOS formatted disks.

Use COPYA under the following conditions:

1. All of a disk is to be copied.
2. The destination disk can be wiped of information. COPYA effectively erases all of the information stored on the destination disk before beginning to move data.
3. The source disk uses standard DOS.

**** SETUP ****

Insert the system master disk in drive 1 and the destination disk in drive two. Boot the disk and when the cursor appears type the following and press the return key:

RUN COPYA

**** PROCEDURE ****

After a short load time the computer will ask for the slot number of the original disk. To see how the process works, let's copy the system master onto the destination disk. Enter 6 for the slot number and 1 for the drive, or press the return key for the default value (The number displayed in the cursor). The "DUPLICATE SLOT" is 6 and the drive is 2. After entering these vital statistics, the screen will display the following:

APPLE DISK DUPLICATION PROGRAM

ORIGINAL SLOT: 6
DRIVE: 1

DUPLICATION SLOT: 6
DRIVE: 2

-- PRESS 'RETURN' KEY TO BEGIN COPY --

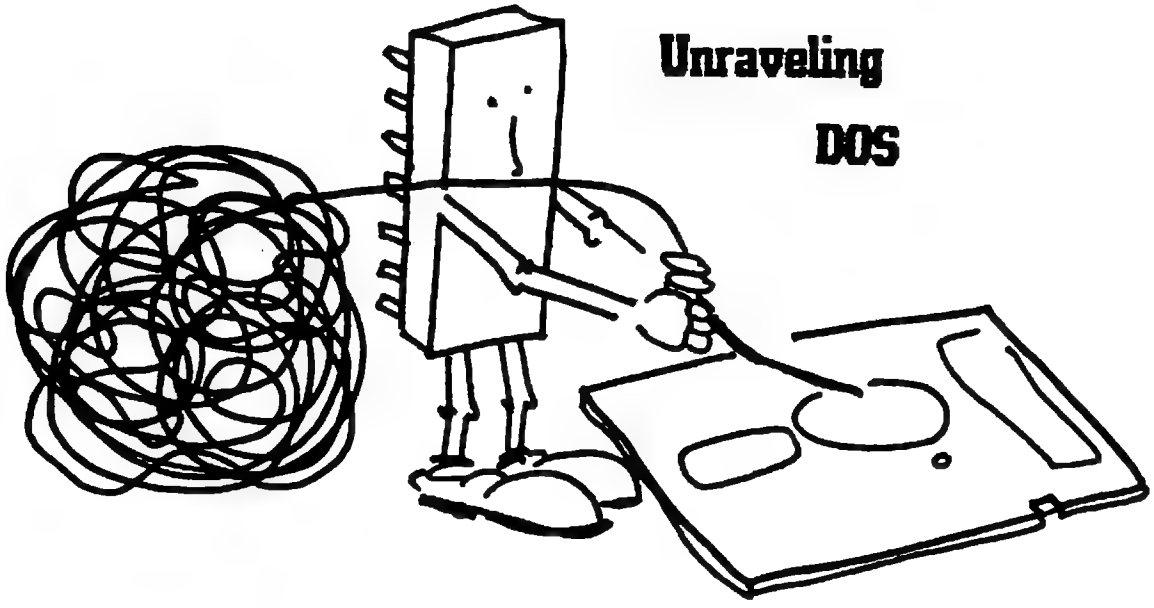
Do so (the return key, of course!) and observe the actions of the disk drive. The first task is for the computer to initialize the disk in drive 2. Familiar sounds

can be heard from the drive as the initialization process begins (see chapter VII). Then the transfer of track information begins. The computer first reads some tracks from the original (the system master in our case) accompanied by the faint little swishing sounds as the read/write head moves from track to track. Then the second drive goes into action in the same fashion. After about 20 seconds of reading from one disk and writing to the other the process is complete. Check by booting the copy.

Bit Copy Programs- Example: CopyII+

**** WHEN TO USE ****

Most commercial software now comes on a copy protected disk in an attempt to foil those who would unscrupulously copy the commercial product and give to others. This illegal copying, it is argued, would reduce the number of packages the company would sell and pinch its pocketbook. What those tricky folks at the software companies are doing to protect their wares is changing the directions for how to read information from the disk. They are rewriting the Disk Operating System (DOS) used by your computer to access the disk. Remember that the DOS is stored on the disk and is moved into memory when the disk is booted. So, when you boot a protected package, the new version of DOS is moved into the computer (See Chapter VII). These changes make it impossible for COPYA and FID type programs to read the information. This protection, though, also frustrate those who legitimately feel that a backup of the original is necessary. Enter the bit copy programs! These programs, along with an occasional input by a knowledgeable user, attempt to unravel the copy protection scheme used on the disk.



A battle is raging between the software producers and the copy program publishers. As the copy programs become more sophisticated, the copy protection schemes become more elaborate. Two years ago, a number of computer oriented magazines were debating whether it was ethical to advertise copy programs. Most have decided that their ethics were not seriously marred by association with the copy companies and are accepting advertising. Maybe in the near future, when computers cover the earth and software is sold at the price of a novel the incentive to make copies will be gone. Until then, let the music play!

The documentation provided with most of the backup programs give many valid reasons for purchasing their software tool, such as the need to protect investments in software, recover or reconstruct information on a disk, check for good disks, and check disk drive speeds. Unfortunately, the list of reasons are usually expanded by users beyond those printed in the manuals and encompass production of multiple copies to trade with other users. If we as users want to see good software produced, such practices are definitely counter-productive. At this stage of the computer software development creative and innovative software won't make it to the stores without your economic support.

Software used for duplicating protected disks are commonly called bit copy programs. Unlike the two previous copy programs described these analyze the smallest storage unit on the disk: the bit. As the program works, it tries to decipher how the information is stored on the disk and then move that information to the second disk. The process can be slow and, in many cases, the end result won't work, especially if it is a recent software release.

Use a bit copy program when:

1. The software to be copied is protected.
2. A damaged data file needs to be copied before sending it back to the company to find out why the information was mutilated. This happened to a data disk used in our media center for storing checkout information.
3. The standard DOS copy program won't work. Sometimes disks that have standard DOS just won't copy. Bring in the big guns and watch the data flow.

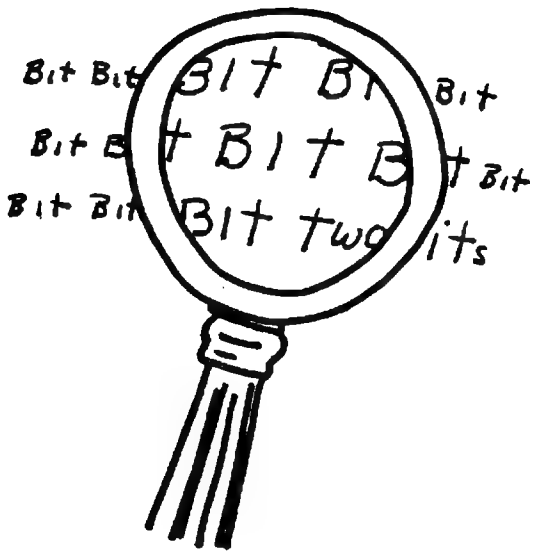
**** SET UP ****

If you have an original(!) of Copy][+ follow along with the procedures described in the Copy][+ manual. If you don't have it, I will describe the steps involved and how the computer does the copying. For this exercise let's copy the system master onto the blank disk again. As in the preceding copy procedure, the duplicate disk does not need

to be initialized. Put the blank in drive 2 and Copy][+ in drive one and turn on the computer.

The menu is quickly displayed as follows:

```
CATALOG DISK
COPY
BIT COPY
DELETE
LOCK/UNLOCK FILES
RENAME FILES
FORMAT DISK
VERIFY
TRACK/SECTOR MAP
VIEW FILES
FIX FILE SIZES
CHANGE BOOT PROGRAM
UNDELETE FILES
SECTOR EDITOR
NEW DISK INFO
BOOT DISK
```



**** PROCEDURE ****

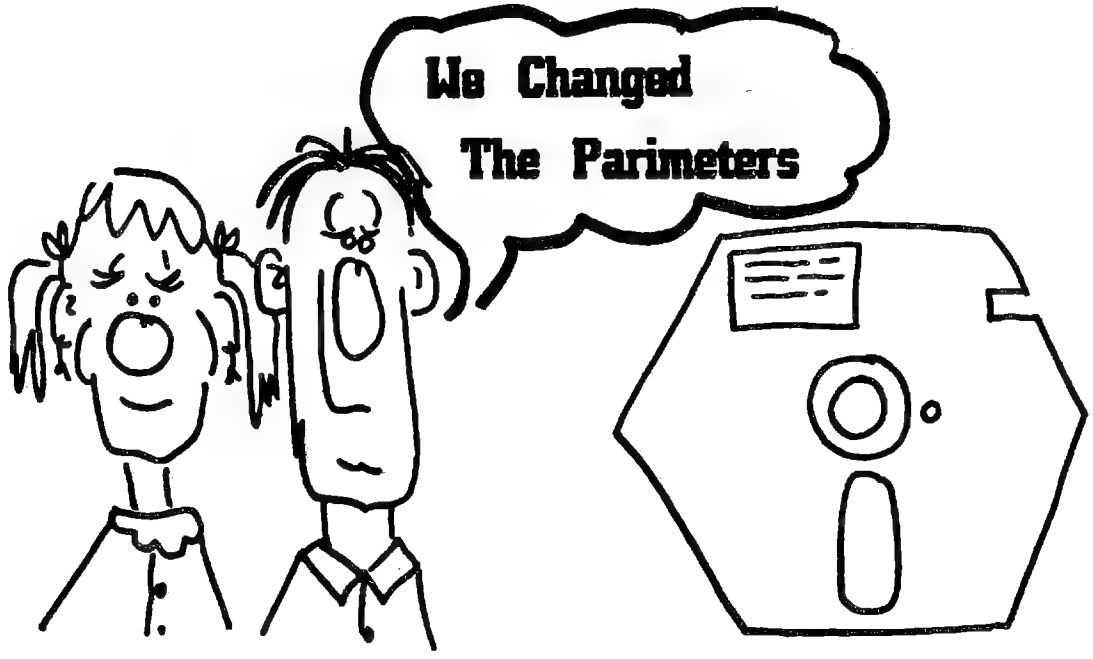
The COPY DISK procedure is similar to the COPYA program above but can copy some non-standard DOS formatted disks and does it in about 20 seconds. The BIT COPY procedure is the one that is usually used for commercial software. Use the arrow keys to move the inverse section "BIT COPY". It will then display the message:

```
INSERT COPY ][ PLUS DISK IN SLOT 6,
DRIVE 1

[CR]-CONTINUE, [ESC]-EXIT
```

Press return. After a brief load of the routine for the bit copy you are prompted with a series of questions about the disk set up and other specifics about the copy process. Press return to each of these if your system is set up as described in the beginning of the chapter. Finally, a menu is displayed at the bottom of the screen.

```
ORIGINAL  DRIVE:     1
DUPLICATE DRIVE:     2

ENTER START TRACK:   0
ENTER  END  TRACK:   22

TRACK INCREMENT:     1

SYNCHRONIZE TRACKS? N

KEEP TRACK LENGTH?  N

-----------------------------------------

      -- INSERT DISKETTES --

RETURN TO BEGIN          Q TO QUIT
ESC    TO RESTART        / TO MODIFY
```

At this time you can give directions to COPY][+ as to how to copy the particular program you are trying to backup. To copy many of the programs on the market requires changes in the directions that Copy][+ uses to read and write information. These are called parameter changes. (Sometimes these are referred to as "perimeter" changes by high school geometry students.) No changes are need for copying the system master, so press return.



Copy][+ grinds into gear by first reading a track from the original disk and displaying what it feels is the start of the track in the middle of the screen. For example, here is a reading of track 0:

```
TRACK: 00  START:  4CCE  LENGTH:179B

     FF  FF  FF  FF  FF  FF  FF  FF
     D5  AA  96  FF  FE  AA  AA  AA
     AA  FF  FE  DE  AA  EB  FF  FF
     FF  FF  FF  FF  D5  AA  AD  B6
     DB  DC  F4  F3  BB  BD  CF  97
     9A  AE  AE  96  AD  AC  9A  AB
     97  B2  B2  AD  AB  9A  9B  AB

SOURCE: 181B    OBJECT:           SYNC
```

D5 AA 96

If you aren't familiar with hexidecimal numbers you would swear you are looking at a very unique language. In the number system used by most micro computers there are sixteen digits: 0 to 9 and then A, B, C, D, E, and F. What is displayed on screen is the interpretation of the information stored on the disk in this hexidecimal number system. Note the D5 AA 96 on the track. This sequence of numbers are used by standard DOS to mark the start of sectors on the track. As the program continues in the process you should see those values in each track display.

As it continues to transfer information, it lists the tracks copied at the bottom of the screen and indicates if there were errors in the process. In the "ERR" row a series of letters will be displayed and then finally a number. The letters stand for the following:

R= Reading information from the source disk.
A= Analyzing the information.
W= Writing the information to the destination disk.
V= Verifying that the information was written correctly.

The "R" below indicates the Copy][+ is (R)eading track 7 from the original (system master) diskette. The "0" under the other track numbers indicates there were no errors in the copying of information from those tracks.

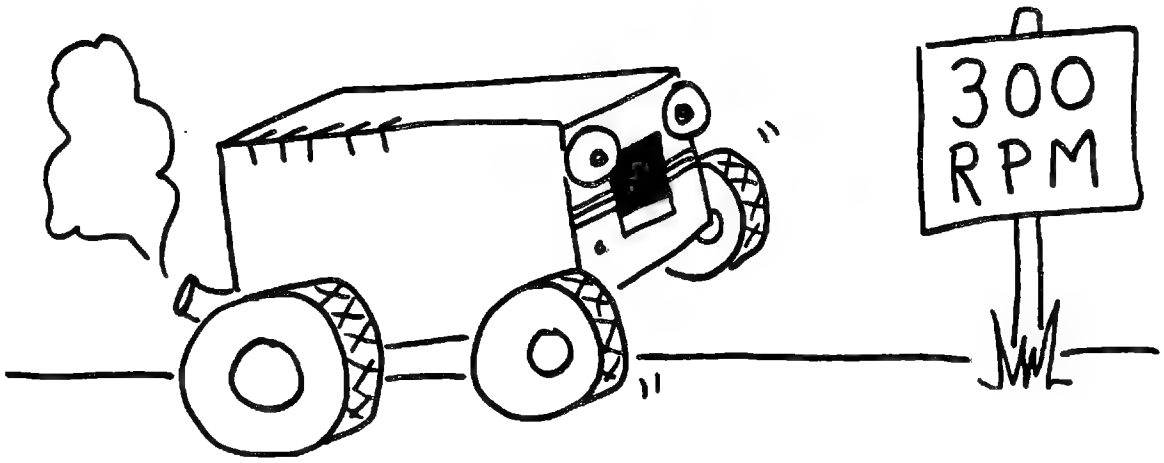
```
                COPY STATUS
HEX 00000000000000001111111111111112222
TRK 0123456789ABCDEF0123456789ABCDEF0123
------------------------------------------
ERR 0000000R
```

When it is finally finished -not a fast process, huh?- try booting the disk.

Duplicating disks currently on the market is not an easy process and usually requires a great deal of knowledge about how disks are protected and how your copy program works. Also, because the copy protection schemes are constantly changing the bit copy programs are usually a few months behind in breaking the protection. Someone has to purchase the commercial software and then spend a great deal of time to figure out the protection scheme. A word from the wise for those who buy offbeat software which has a small audience, such as "Educator Euphemisms": No one is going to spend much time figuring out the protection strategy for your disk. Treat it well!

A copy program like Copy][+ can also be used to back up data files that might be partially damaged, and in some rare cases, even fix them. It can also print information from a file that has been damaged. Most of the copy programs also provide one other extremely valuable service: checking the disk drive speed.

DISK DRIVE SPEED TEST



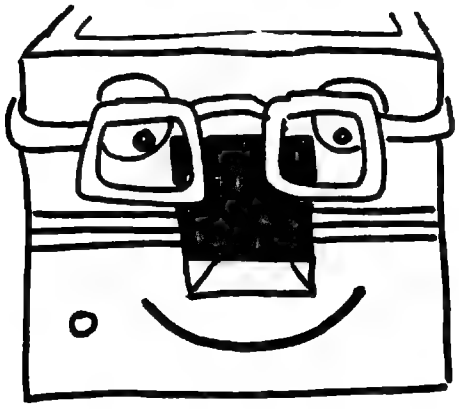
The disk in the drive is suppose to revolve at about 300 revolutions per minute for the best read/write results. If it is much slower or faster information will be lost, disks won't read properly, and bit copy programs won't succeed in the copy process. Some software is sensitive to speed and, if the drive motor is not up to snuff, tend to do strange things like store data on the disk label or the back of your hand!

How often should you check the disk drive speed? Some people check their drives as often as every two weeks. These are fanatics, quality control engineers out of control, or people with a lot of time on their hands. Those who are doing a great deal of important data transfer to and from

disks might need to check drive speeds at frequent intervals. Others, such as the author(!) check the drives when the following conditions coincide:

1. An apparent disk problem occurs ("I tell you it just ate the plastic right out of the disk and threw the jacket at me!").
2. The tools are available (the speed test disk, a scratch disk, the phillips screwdriver from the trunk of my car and the small screw driver from my wife's sewing box).
3. The disk drive is visible among the clutter on the computer table.

The time span between checks ranges from two months to a year! Whatever schedule you pursue remember that checking the disk drive speed can't hurt so do it with a warm feeling knowing that your disk drive always appreciates the attention.



An Appreciative Disk Drive

Most of the bit copy programs have a routine on the disk for checking the disk drive speed. For this example I will again use the program COPY][+. For a list of other programs for copying and checking disk speed, consult Chapter II. Do the following steps if you have the program (also read their directions in the manual). If you don't have the program or one similar to it, read along to see what checking the drive speed is all about.

Step 1: Remove the cover from the disk drive(s) to be tested. Use the directions in the preceding chapter to help you.

Step 2: Insert the copy program (Copy][+) and boot the system and wait for the menu to appear.

Step 3: Select VERIFY. To the right of the menu will appear four options. The program is asking which one you want to verify:

DISK
FILES
IDENTICAL FILES
DRIVE SPEED.

Step 4: Select DRIVE SPEED. At this point it asks which disk drive to verify. Select the one you want.

Step 5: Now it asks you to insert the Copy][+ disk into the drive to be tested. The Copy][+ disk can't be write protected! I get very nervous when my software is naked to the world so I usually insert a scratch (blank or junk) disk. Using a disk other than Copy][+ won't affect the test results.

Step 6: Press return to begin the test. The program will then give a reading of the disk drive speed in microseconds and specify a range for the speed (198-202 microseconds). Example:

DRIVE SPEED SHOULD BE BETWEEN 198.0 MS.
AND 202.0 MS.

DRIVE SPEED IS 200.1 MS.

To calculate the speed, Copy][+ writes to a location on the test disk (this is why the disk can't be write protected) and then times how long it takes for that location to make a complete rotation. Thus, the longer it takes the greater number of microseconds recorded, and the slower the drive is going. This number will fluctuate a few tenths of a microsecond as the disk rotates, which is normal.

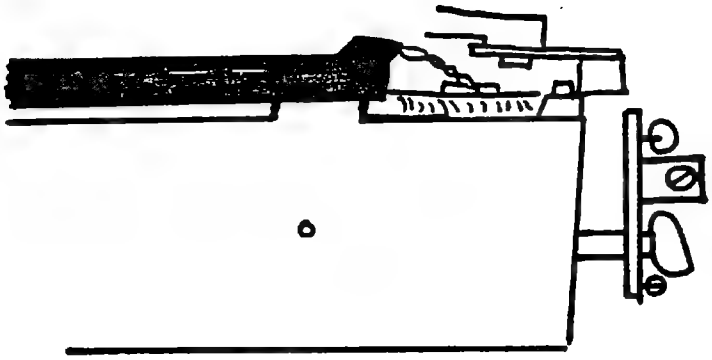
Step 7: Now to set the speed. Most sources have recommend setting the speed so that it is slightly slower than the recommended speed. The argument goes that as the system ages parts get looser and the friction decreases, causing the disk drive to run faster. From the tests I have done on drives, this seems to be a valid point. I usually adjust the drive speed at about 200.5 microseconds.

Note: Other drive speed programs, such as Locksmith, show a graphic display of the speed with dots indicating the drive speed and no numbers

given. I usually set the dot indicator to near the mid line (corresponds to 200 microseconds on the Copy][+ program) on the SLOW side of the display.

SLOW FAST

To adjust the speed turn the speed adjust screw in the back of the drive with the drive running.



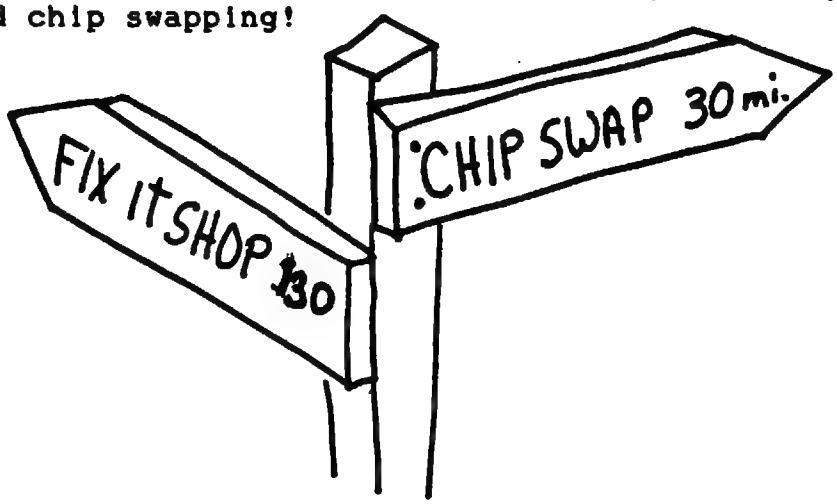
Turn it a little and then note the response on the screen. Continue to adjust the screw until the speed is where you want it. Now, test the other drive (if you have two) by pressing the ESC button and selecting the same options except the disk drive choice.

That's about all there is to the speed adjustments. If this doesn't solve some of the problems that occur, it sometimes helps to switch the drives around. Also, when using bit copy programs with two drives, its a good idea to have the drive speeds the same on each device.

A last note on disk drives and repair. If a problem has been isolated to a drive, and chip swapping, cleaning, and the speed adjustment did not solve the problem, then it's time to drive the drive to the garage. A few other adjustments can be made on the drive but these require knowledge and equipment that is best left to those in the service centers.

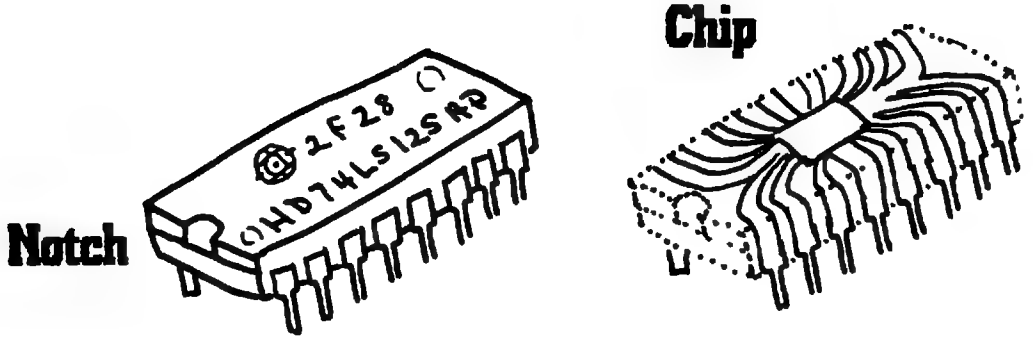
Chapter IX: Chip Swapping Procedures

It has come to this: the problem in the computer system has been diagnosed and isolated to a module as described in chapter V. At this point the road divides and you could follow the path well traveled to the computer service center. But no, you have chosen that not so poetically named path called chip swapping!

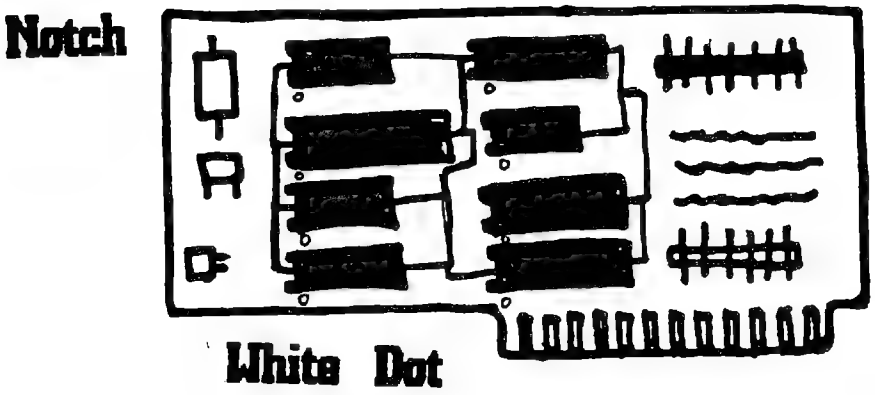


This route is the last resort for the brave and patient user. This rugged individualist not only fixes his/her flat tire, eats the right cereal, but also dabbles in high tech repairs.

Now that the juices are flowing properly we can describe how to test the chips. Before doing the swap, though, let's take a look at a chip. The black chips in the Apple computer are actually just holders for the integrated circuit that is embedded in the plastic body. The chip itself is about an eighth of an inch square in most of the chips and is connected by thin wires to the fingers that stick out of the plastic. On each chip is a notch at one end or a small dot. Examine the chips in the computer and look for these traits.

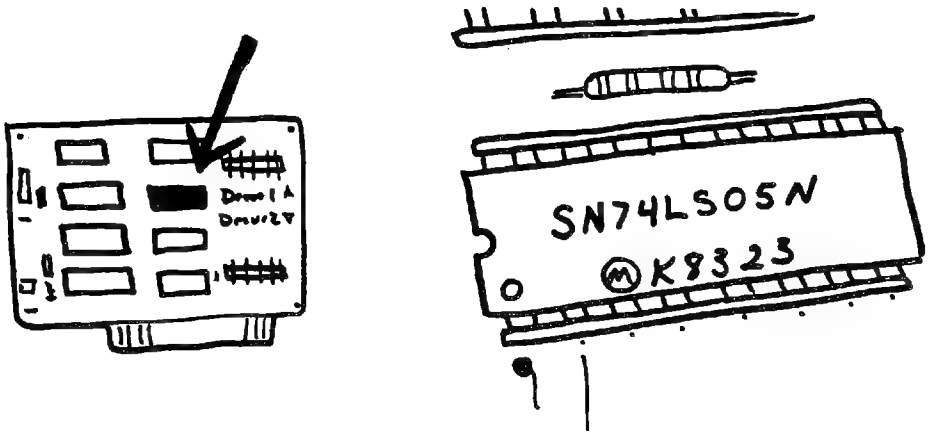


The art of chip swapping is the same no matter which board you are diagnosing. It is extremely important to have the chips properly oriented in their sockets. Be sure the computer is off and remove the disk interface board from its slot. Observe how the chips are socketed. Notice the little white dot on the green circuit board near one end of a chip. For easy reference when putting circuits together pin connections are numbered, starting with one and continuing through the total number of pins. The white dot marks where the hole in the socket for the number one pin is. Each chip also has a marking; either a notch or a small dot on one end. This mark labels the end of the chip which has the number one pin. When inserting chips be sure the notch or dimple on the chip is at the same end as the white dot.

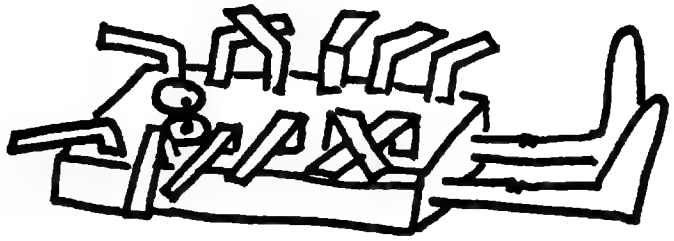


Be sure to handle chips with care. Ground yourself on the power supply and avoid bending the pins on the chips. Handle the actual contacts as little as necessary.

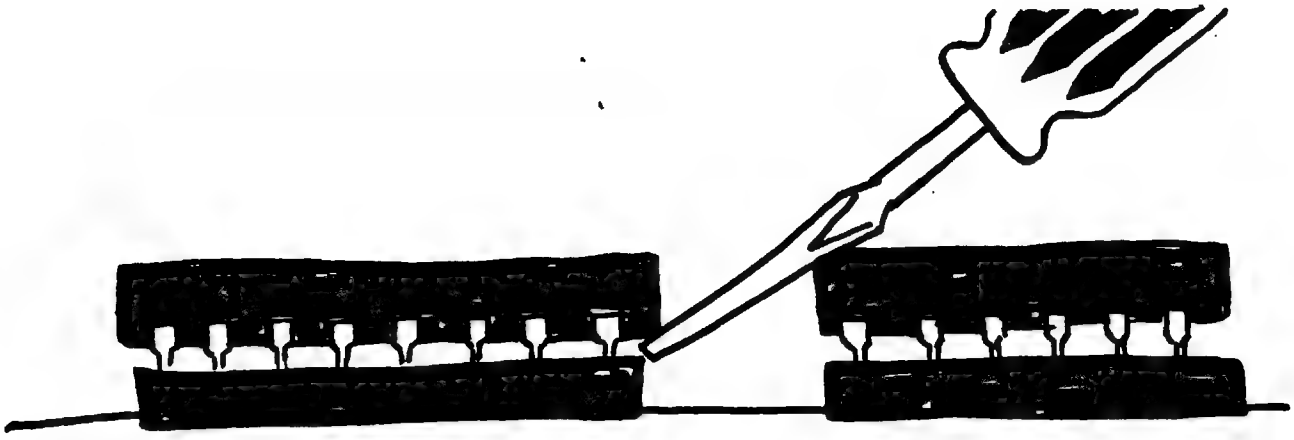
Now to remove and insert a chip. Lay the disk interface card on a soft surface, chip side up. Now locate the chip that has LS05 printed on its top. Usually, the "LS05" is imbedded in a string of numbers and letters on the chip. For example, the top of the LS05 chip often has printed "74LS05". Most of the chips also have their names imprinted on the green board near the socket. Locate the "LS05" on the green board near the chip.



Using the chip pullers, grasp both ends of the chip and pull up with a slight rocking motion to work the chip out of the socket. Never use your fingers to do this! Besides getting stabbed with a pin often your fingers slip and one end of the chip comes out first and the pins on the other end come out bent.

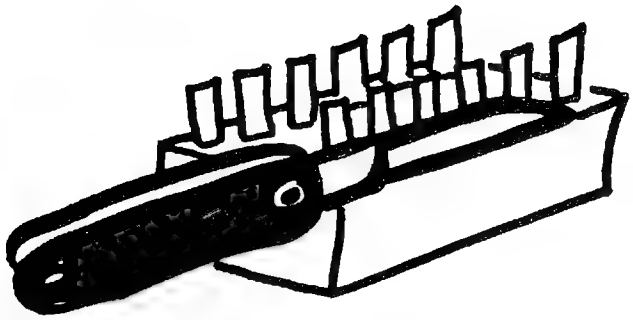


Removing larger chips or stubborn ones sometimes require some not-so-gentle persuasion. I usually use a small flat blade screwdriver or a knife to wedge up one end of the chip and then the other. The chips are extremely tough and can take a lot of pressure to their bodies. Occasionally I use one chip to give leverage to another chip. The same is not true for those fine little metal legs. Once the chips are loosened, use the chip pullers to remove them.

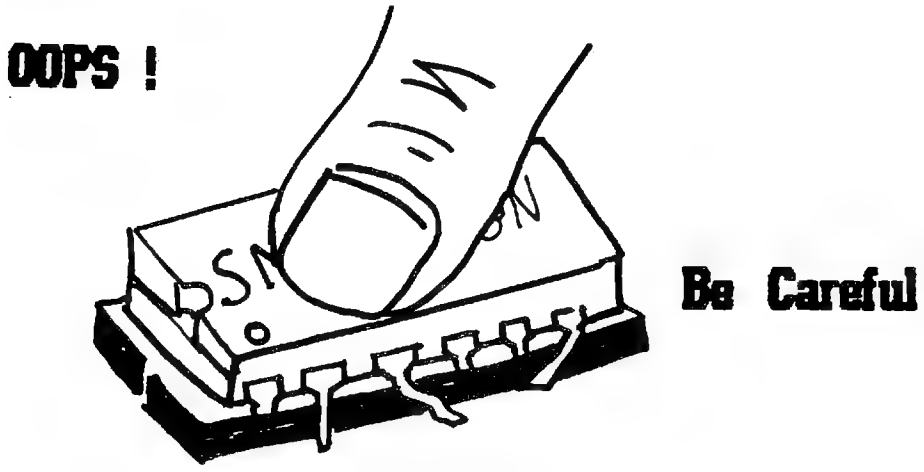


If a pin is bent in the process, use a knife, fingernail, or a flat edge to bend the pin back in position. To do this, place the knife edge flat against the surface of the pin and apply pressure to the whole pin. I have managed to

straighten badly mangled pins by using this method without breaking them off. My thanks to our shop teacher, Wes Ramsey, for this suggestion.



When it comes time to put the chip back in first ground yourself and then check the orientation of the chip to the socket. Is the notch on the chip near the white dot on the board? If it is then grasp the chip at its ends with your fingers and start one row of pins into the socket. Then apply pressure against those pins and direct the other row of pins into its receptacle. Usually the metal fingers tend to be spread a bit wider than the socket and so pressure is used against one row until the other row lines up with the socket. Finally, press the chip into position.



The Art of chip swapping

One of the nice things Apple did was to socket rather than solder most of the chips used in their systems. This makes it possible to remove individual chips and test them in a good system (this process should sound familiar!).

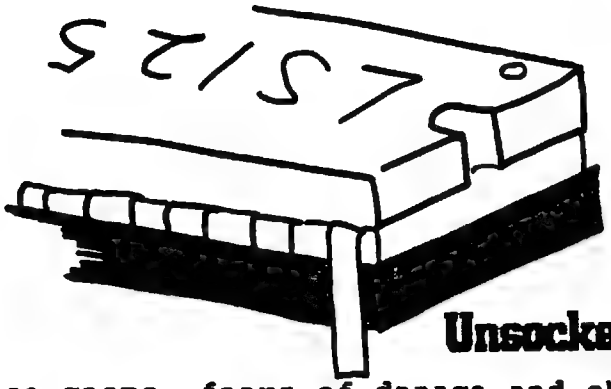
Though Apple is soldering more chips in on the new computers, there are still enough socketed ones to make chip swapping useful. Any of the socketed boards can be tested: the mother board (a long job!), analog card on the disk drive, the disk interface card, the eighty column card, the printer card, etc.

The process, as one of our students told us, is very similar to testing a bad string of christmas tree lights. These are the type of lights that if one goes out they all go out! First, you need a good string of lights and then one by one you remove a bulb from the bad string and insert it into the good string. If the good string lit up the bulb had to be good. If it didn't, the bulb was bad and needed to be replaced. The process continued until all bad chips..er.. bulbs were found.

Let's try this process with the analog card on the disk drive. If you are lucky enough(?) to have a bad disk drive this is the time to bring it out for testing. If not, we will make a problem. Note: to do these tests a good module is needed to test the bad module. In this example, a second drive is needed. First boot your good system with a test disk to be sure it is functioning properly. Now, follow these steps:

1. Remove covers: Take the tops off of both of the disk drives. Mark the "bad" drive with a piece of masking tape.

2. Create the problem: Remove the LS125 chip and carefully bend the pin across from the number one pin out. Reinsert the chip with this one leg unsocketed. You don't need to seat the chip all the way in- just enough so all of the other pins make contact.

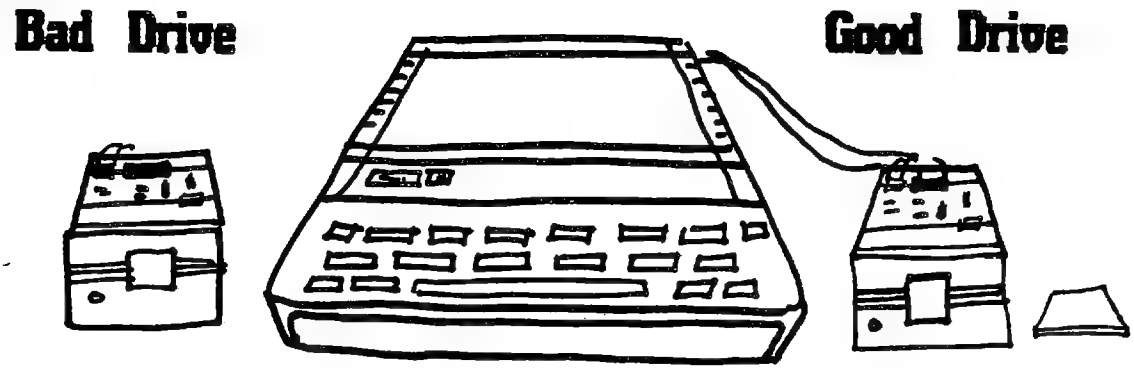


Yes, we hear those gasps- fears of damage and shock that we would suggest mutilation! But remember, this is a learning process and the best way to learn is by doing. Besides, this chip is priced at about $1.25. If bumbling fingers break off a pin it isn't an expensive replacement. Also, this chip is the most often replaced

chip in the Apple II computer and if you plan to do chip swapping you might as well practice on this one.

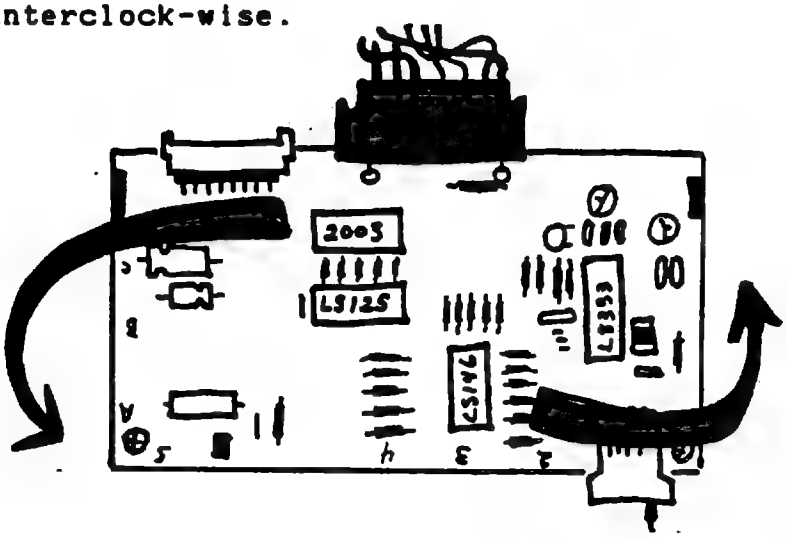
3. Test Bad Module: Connect the "bad" drive to the system, insert the test disk, and try to boot the system. Observe what happens. The read/write head should retract to the 0 track and do nothing. You have isolated the problem to the drive module since it is the only change made in the good system. Good job!! The drive is bad and under "normal" circumstances would need to be sent in for repair. But the following procedures takes the concept of modular isolation one step further. Consider the chips as modules which can be tested in a good system to find bad ones.

4. Setup: Disconnect the bad drive and place it on the left of the computer. Connect the good disk drive to the system and test it, again to be sure the system is functional. Place the good drive on your right and the right of the computer. Put a protective pad next to the good drive.



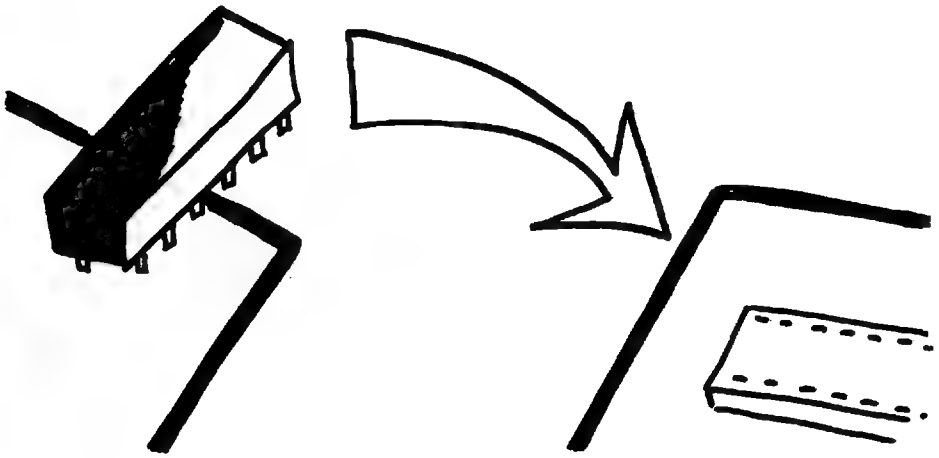
5. Planning: Now for checking the lights, uh, chips. The positioning of the drives, computer and pad as above is important so that chips don't get mixed up. The general rule is that the good chips never cross over the computer and the suspected bad chips never cross over the good drive to the pad. This way good chips never get mixed up with the bad chips.

First, systematically plan the attack. In what order are the chips going to be tested? For the analog card, start in the upper left corner with the ULN2003 chip and work counterclock-wise.



6. Remove good chip: Be sure the power is off and ground yourself at each chip removal and insertion step. Remove the good ULN2003 chip and put it on the pad.

7. Remove and test suspected bad chip: Remove the suspected ULN2003 chip from the bad drive and insert it into the good drive in the proper orientation. Insert the test disk and turn on the computer. If the system boots properly the chip is good. If it doesn't the chip is bad or a pin accidentally was bent under the chip. In this case it should check out OK.



8. Replace chips: Turn the power off and ground yourself. Remove the ULN2003 chip from the good drive and put it in the bad drive. Return the ULN2003 chip on the pad to the good drive.

****

NOTE: Even if the chip tests out good, return all chips back to their original location-- don't leave the ULN2003 chip from the suspected drive in the good drive and put the good chip in the suspect drive. If chips aren't restored to their original sockets, other problems that haven't been identified in the module can be transferred to the good drive.

****

9. Repeat process: One chip has been tested. Do the same for the LS125 and be sure to have the pin bent out slightly when putting it in the test disk. Does the system work? If not then that is a "bad" chip and needs to be replaced.

10. Test all chips: Continue testing the other chips in like manner. One bad chip does not guarantee that there aren't others. In fact, usually both the LS125 and the 3470 chips take a dive when the disk drive is connected to its interface card incorrectly.

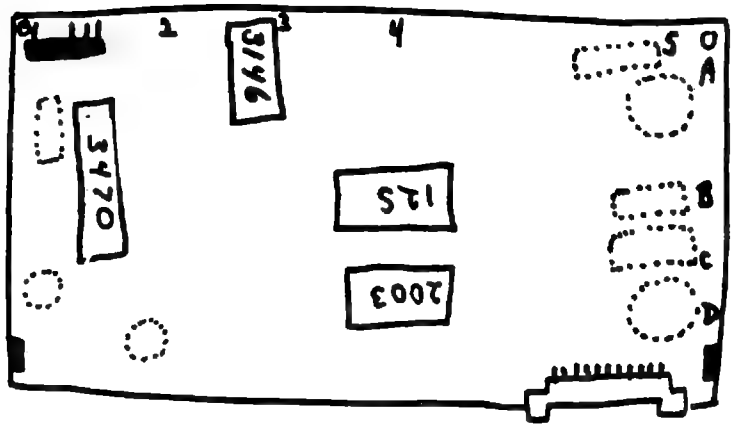
11. Mark bad chips: When the process is completed all of the chips in both drives should be back in their original sockets with the bad chips properly marked in some way. Since I like to use chips for bugging equipment in repair classes, I usually mark their underbellies with a swipe of whiteout and add them to my chip collection.

Now that the bad chip(s) have been located, what to do?? Since we work with over 250 computers we keep a lot of chips on hand. For the person with only one computer and maybe a friend that has one, it is a good idea to buy only a few of the most commonly zapped chips and wait until the others go bad before buying them. Always take the chip in with you to the electronics store- it will speed up the process.

Here is a list of the chips in the Apple computer and the ones that are hot items and should be purchased. The "location" is the intersection of the letter row and number column on the card. For example, on the disk interface card the LS125 is in the row marked B and column 4. See chapter III for further explanation. Most of the chips are priced between one and five dollars. The chips which are marked as "Apple" products usually must be purchased from Apple.

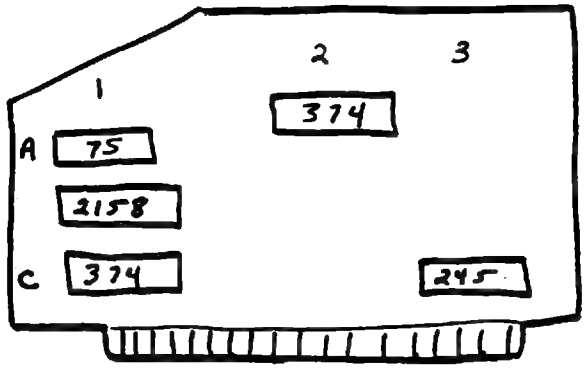
Chips for Computer System

DISK DRIVE ANALOG CARD



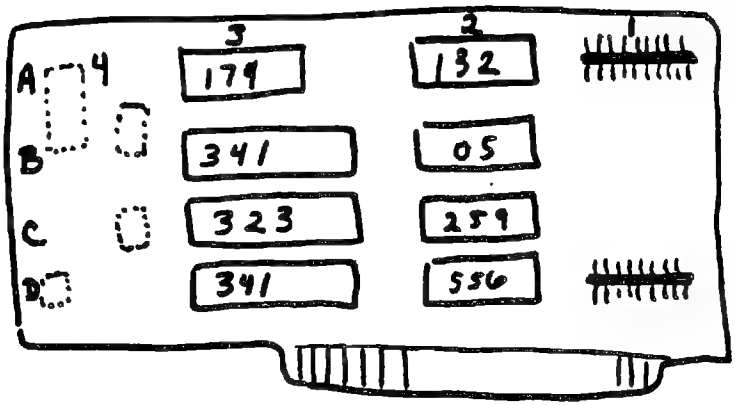
Chip	Buy(yes/no)	Location	Comments
ULN2003	no	D4	* Rarely has this one gone out.
LS125	yes!!!!	B4	* A must! If the drive has a bad chip it is always this one.
CA3146	no	A3	* Few problems.
3470	yes	B1	* Often goes with the LS125 chip.

80 COLUMN CARD



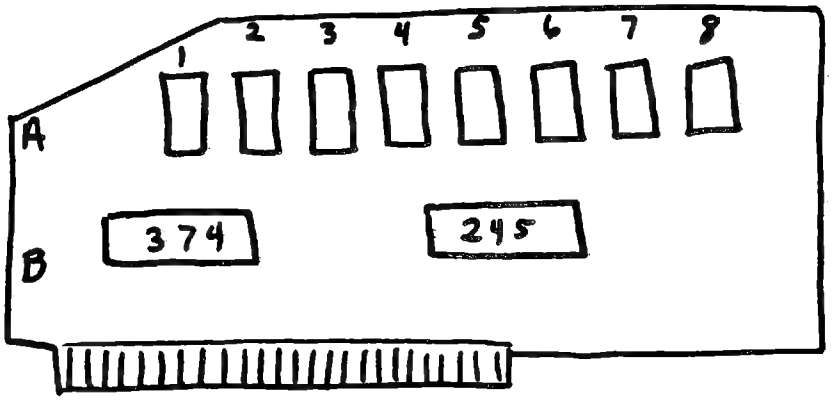
Chip	Buy(yes/no)	Location	Comments
LS75	no	A1	* No problems.
LS374	no	A2,C1	* No problems.
LS245	yes	C3	* Occasional-in other cards.
SY2158	no	B1	* No problems.

DISK INTERFACE CARD



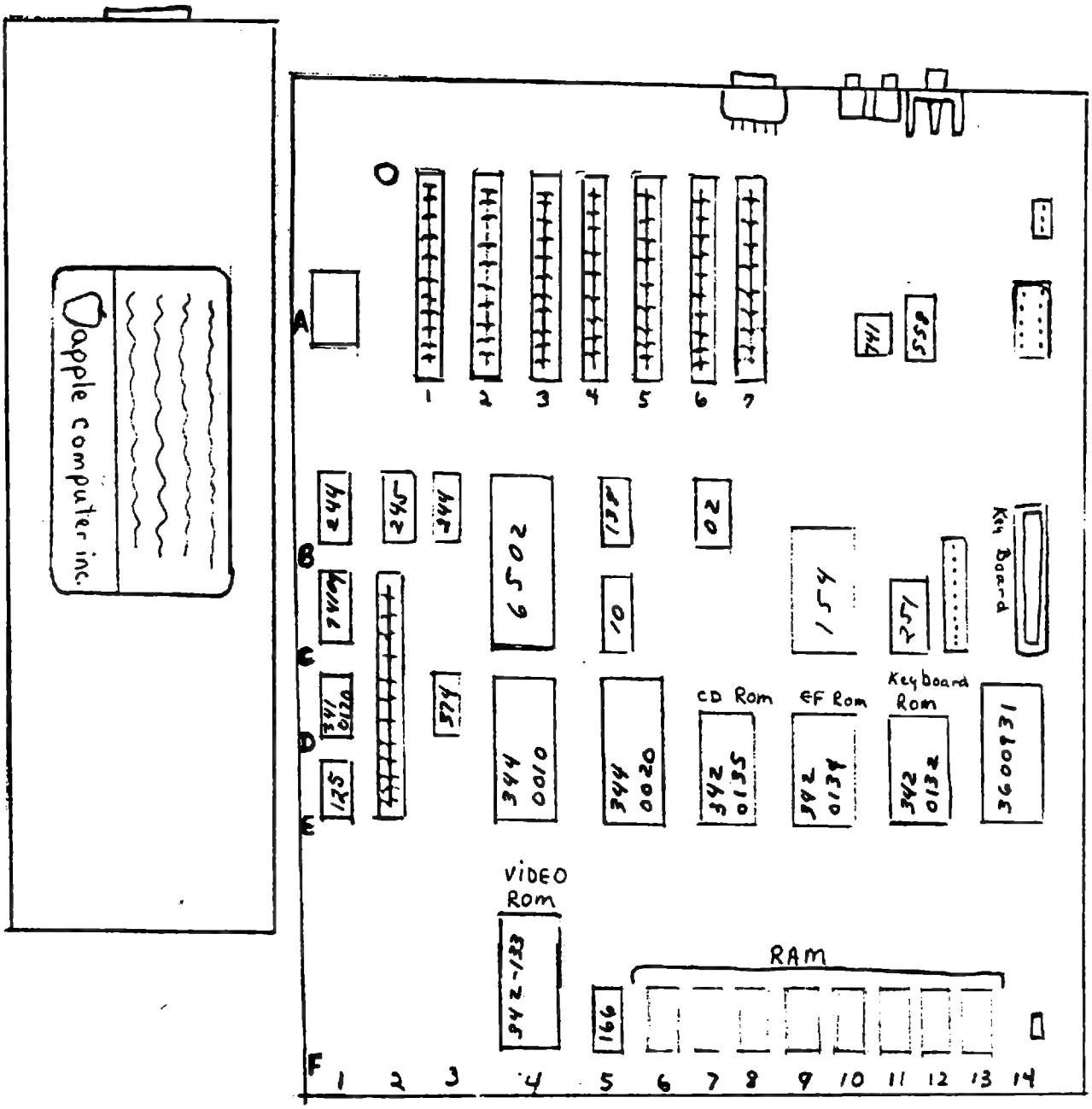
Chip	Buy(yes/no)	Location	Comments
LS174	no	A3	* No problems.
341-002-01 (Prom P6)	no	B3	* Apple product.
LS323	no	C3	* No problems.
341-0027 (Prom P5)	no	D3	* Apple product.
LS132	no	A2	* Few problems.
LS05	no	B2	* Some problems.
9334	yes	C2	* Same as above. Same LS259 chip.
NE556	no	D2	* Rare problem.

EXTENDED 80 COLUMN CARD



Chip	Buy(yes/no)	Location	Comments
LS245	yes	B1	* Some problems.
LS374	no	B5	* No problems.
RAM Chips	no	A1-A8	* See RAM under mother board.

MAIN BOARD DIAGRAM



MOTHER BOARD CHIPS

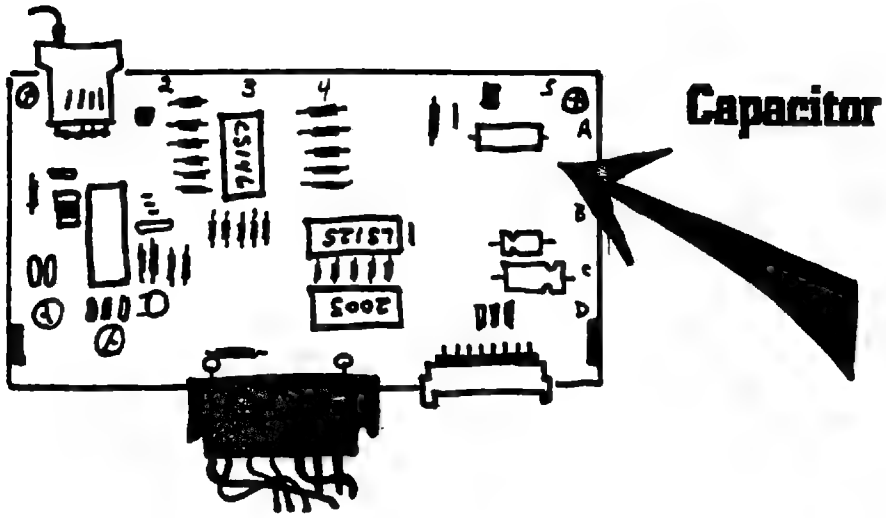
Chip	Buy(yes/no)	Location	Comments
MM741	no	A11	* No problems.
NE558	no	A12	* No problems.
LS244	no	B1, B3	* Rare- but all chips are rare problems on the main board.
LS245	yes	B2	* Rare- but also on the 80 column card.
LS138	no	B5	* No problems.
CPU (6502)	no	B4	* No problems.
LS02	no	B8	* Rare problem.
74109	no	C1	* No problems.
LS10	no	C5	* No problems.
LS154	no	C10	* No problems.
LS251	no	C11	* No problems.
341-0170	no	D1	* Rare problem Apple part.
LS374	no	D3	* No problems.
344-0010	no	D4	* Apple part-no problem.
344-0020	no	D5	- - - -
CD ROM (342-0135)	no	D8	- - - -
EF ROM (342-0134)	no	D10	- - - -
Keyboard ROM (342-0132)	no	D12	- - - -
AY3600931	no	D14	- - - -
Video ROM (342-133)	no	F4	- - - -
LS166	no	F5	* No problems.
RAM chips	no	F6-13	* Few problems.

So your bag of chips includes: LS125, 3470, and LS245. You won't even need a tool chest or have to rob a bank!

Many people have been scared off from chip swapping by fear of damaging the system. Will a bad chip in a good system cause "decay" in that system? In my experience with 1000+ swaps this has not happened. What more reassurance could you want?!! Essentially the "wires are broken" in the chip so there is no flow of current. If the chip has melted to the point where it looks more like one of your kid's plastic animals then maybe it could cause damage in another module. But then, you could also tell that the chip was not functioning properly.

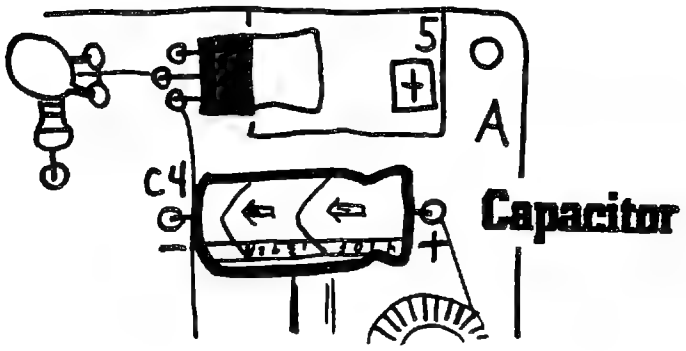
All of the cards are fairly easy to work with except the motherboard. Gain some experience with the easier boards before tackling the big one. When the time comes when you need to chip swap the main board, start with the ones that have a "yes" on them in the chip list. If those don't do the trick, then systematically check each of the other chips. I have had about 8 bad main boards in the last year. All of them were fixed by swapping chips.

One other item that can be fixed for about 40 cents is a blown (literally) capacitor on the analog card of the disk drive (location A5).



If tell-tale signs such as the casing is off to one side, the two wire leads are wrenched in the same direction, fluff is stuck to parts on the drive and floating in the air, and a rubber stopper on the capacitor is hanging on the wire like a bead on an abacus then that part is ripe for replacement.

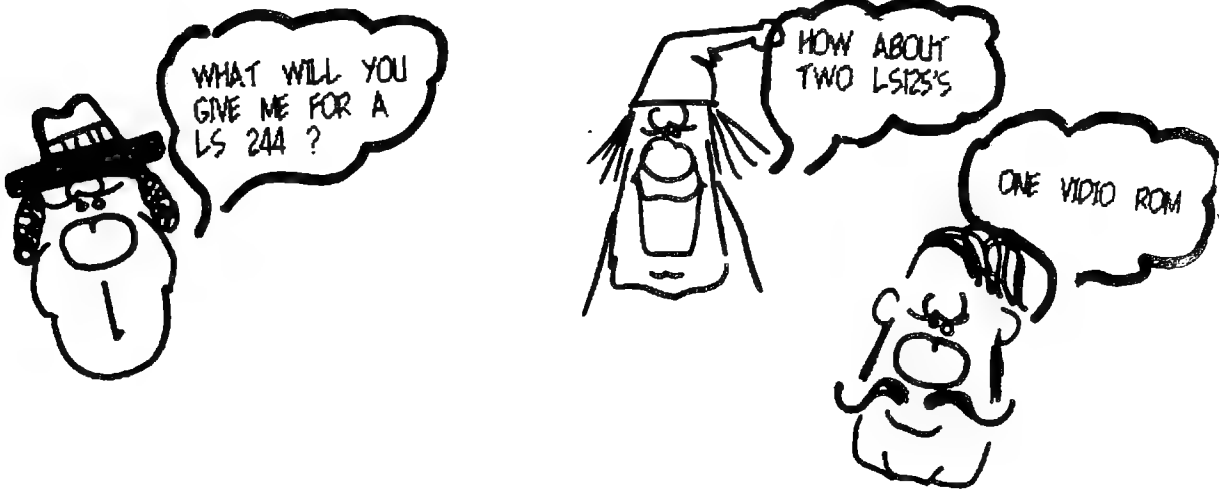
To replace the capacitor, purchase one which will work (ask your friendly electronics person to look at yours) and will fit under the cover. Remove the analog card from the drive and unsolder the capacitor. Orient the plus (+) and minus (-) connectors so they correspond to the markings on the analog card.



Put the leads from the new part in the holes and solder them in place. Snip off the excess wire and bend the capacitor so that the cover will fit over it.You will probably need to check chips as well when the capacitor is blown.

Occasionally, you will test all the chips on the board without finding any culprits. Before taking the part to the computer store for repair check the bad system in the computer. Sometimes all that sweat, swearing, and reseating of chips scares the computer into compliance. Actually, the reseating of the chips sometimes re-establishes contacts that had become corroded.

Good luck with chip swapping. Work slowly and carefully. If you are in a pinch for time then this process should wait. The end result of a hurried job is a chip that ends up backwards on the board or another burned out chip.



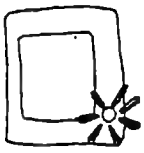
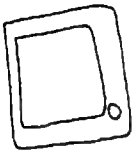
Chapter X: Test Problems

During the course we teach on computer maintenance and repair participants are challenged to solve over thirty system "bugs". Most of these problems were ones that we had to deal with during the last three years of keeping a school district's computer running. Her is a sampling of these bugs for those who would like to challenge their problem solving skills.

The problems are divided into two major categories. The first type is the "fixable" kind. These can be repaired on site and don't require module isolation or exchange. These defects can be solved by using observation and following the "simple procedures" outlined in chapter V (chip pushing, checking connections, etc.)

The second type are more troublesome and require module switching. It is assumed that all the simple solutions have been tried and the symptoms still persist. These "reduce to module" puzzlers test a student's ability to apply the five step diagnostic procedure given in chapter V.

In these examples visual indicators are shown with each problem to indicate the status of the system. The disk drive light, computer light, the speaker in the computer and the monitor display are illustrated for you to compare with your bugged system. Here is a key to the illustrations:

DRIVE		COMPUTER LIGHT		COMPUTER SPEAKER		MONITOR	
							
ON	OFF	ON	OFF	ON	OFF	ON	OFF

These are test situations but you could also use these examples to help diagnose real computer problems. The monitor display will also show what typically appears on the screen during each bug attack. A description of the malfunction and what caused it is provided as well.

And now for the...

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FIXABLES
(ON SITE MAINTENANCE)

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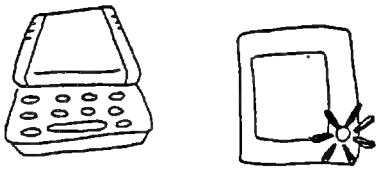
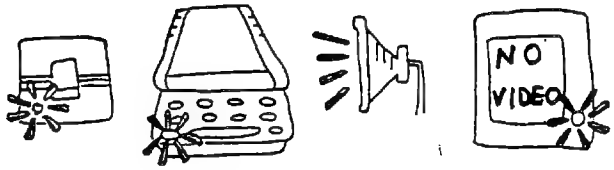
Directions: Use the "simple solutions" from chapter V to diagnose these problems. These can be repaired without module exchanges or chip swapping.

1. **Symptom:** The computer seems to be dead. The monitor light is on but no screen is displayed.



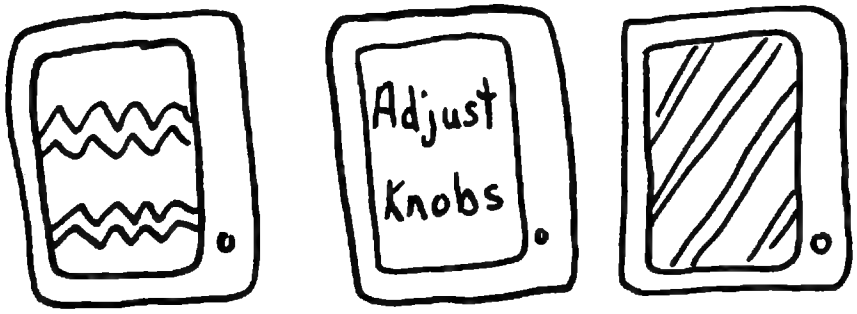
Reason: The power cord is loose at the power source. Dumb, huh?! We have fixed a lot of computers by pushing in plugs. You can create this symptom by loosening the connection at the computer end of the power cord.

2. **Symptom:** No video image. All other indicators function normally: the disk boots, the computer light is on, the speaker beeps.

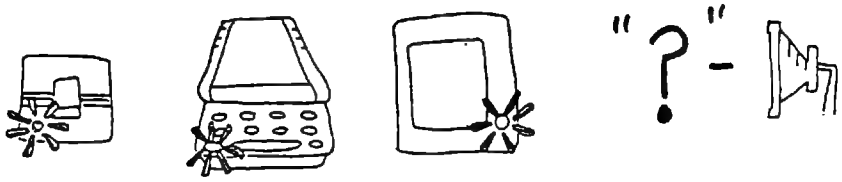


Reason: Both the "bright" and "contrast" adjustments are set incorrectly. The contrast knob is usually in the front of the monitor and the bright is in the back. To create this bug, first check each knob separately to see in

which direction they have to be turned so that the screen goes black. Then, turn <u>both</u> knobs in that direction. Both knobs have to be adjusted properly before the picture will return to normal.

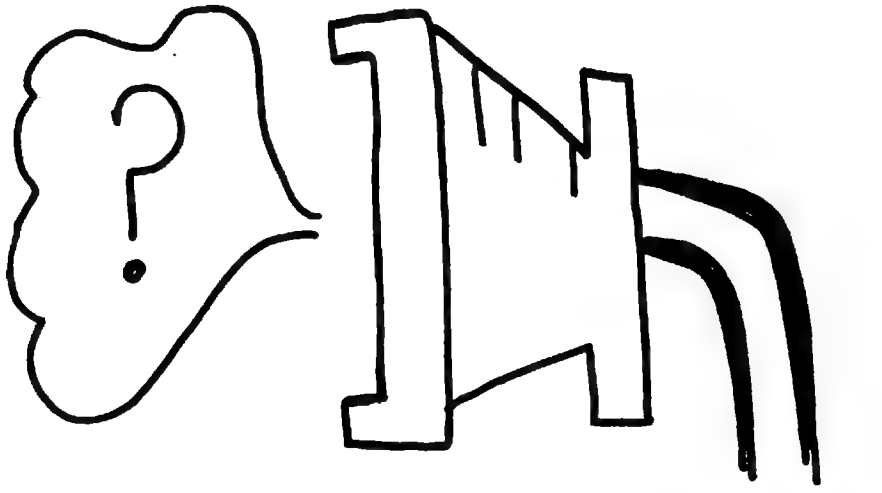


3. **Symptom:** The computer seems to work correctly except the speaker does not make any sounds.

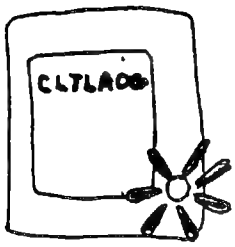


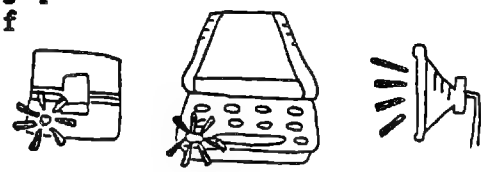
Reason: If you are a teacher, this is one problem you need to know how to create and fix. Much of the software for the Apple makes use of the speaker which can be very annoying at times. Sometimes the little shavers like to disconnect the speaker so teachers or supervisors don't hear sinful gaming sounds.

To disconnect the speaker open the computer, reach under the keyboard and pull the speaker plug from its connection. To make the problem a little harder to detect, plug the connector onto just one of the two pins. It will appear to be attached properly, but nothing will pass the speaker's lips!



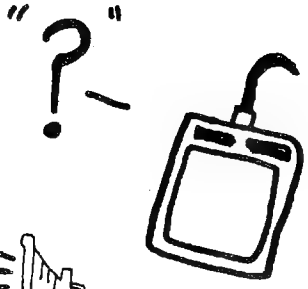
4. **Symptom:** The system runs correctly but the visual appearance of the keyboard tickles your mind. All is not right. A touch typist friend types CATALOG and "CATALOG" appears and a list of the files is displayed. Your hunt-and-peck typing produces "CLTLAOG" instead of "CATALOG".

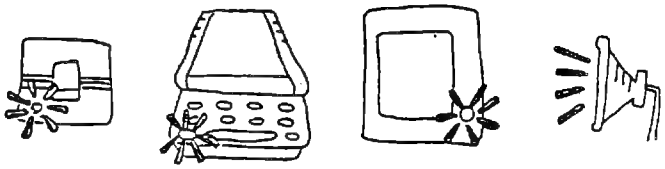




REASON: If you happen to run around with the wrong crowd this little problem is bound to come your way! Yes, the "A" and "L" keycaps have been switched. Remove the caps carefully and then refit them on opposite stems as described in chapter III.

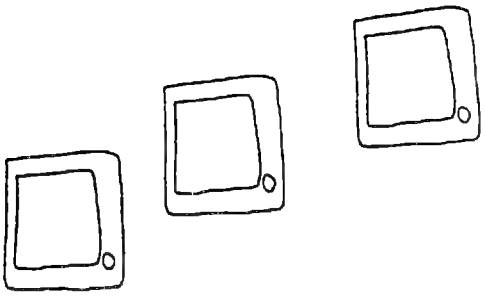
5. **Symptom:** The system functions properly, but the paddles, joysticks, pads, etc. don't work.

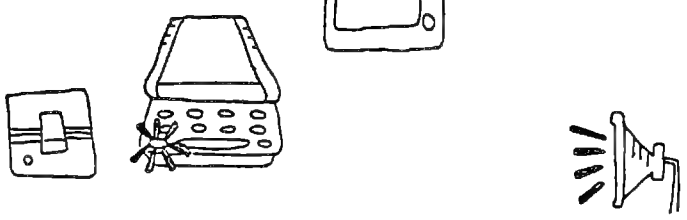




Reason: The paddles, pad, etc. connector is inserted backwards in the input/output socket of the computer. Instead of having the notch (if there is one!!) facing toward the keyboard it is aimed at the back of the computer. The pad or joystick will not work if the paddle test is used. See chapter IV for the test program.

6. **Symptom:** When the computer is turned on it beeps, makes weird sounds, the screen roles through a series of different displays, the disk drive refuses to work, and the poor fool who turned on the system will have a heart attack!





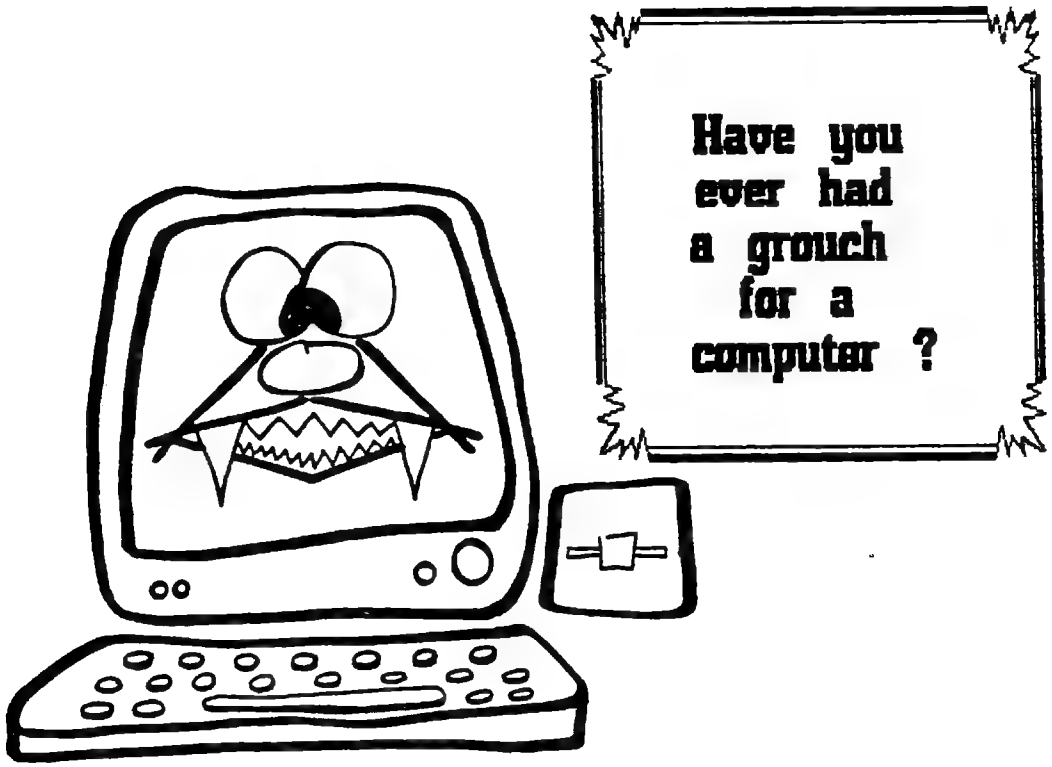
Reason: One of my favorite bugs! The Apple IIe computer has a built in test of the system that can be activated by holding down the control key, the closed apple and the reset key at the same time. The computer will begin a series of tests and after a few seconds will display the message:

KERNEL OK

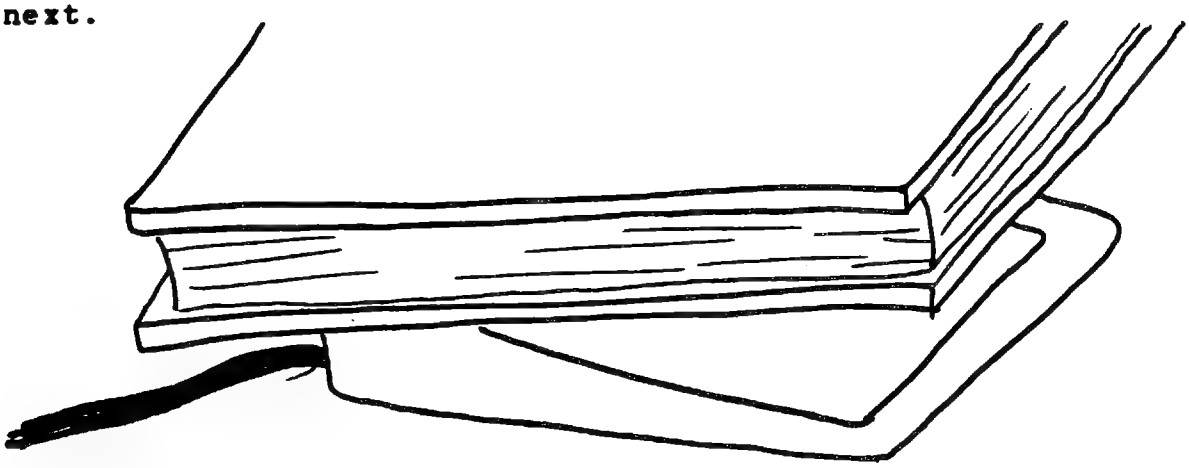
You can also include the open apple key with the other three and the computer will do the same test but will include weird sounds befitting the best science fiction movie.

How can you get the computer to go into this test pattern for an unsuspecting victim? After having it happen to me many times I finally realized how it can be accomplished. The two apple keys on the sides of the space bar are connected to same location in the computer's memory as the push buttons on the paddles, pads, and joysticks. Soooo...

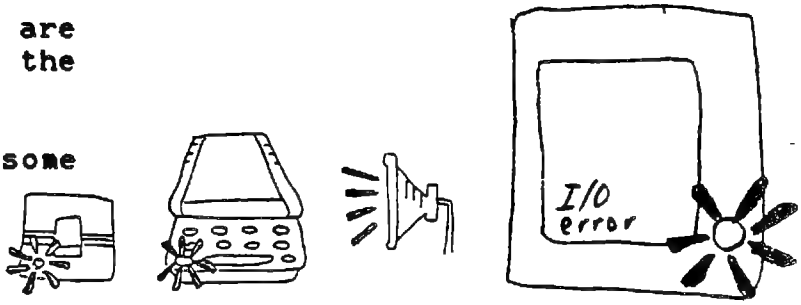
Paddles and joysticks: Plug in the paddles or joystick. Then, use clear tape to hold the push buttons in. This is the same as holding the two apple keys down. When the computer is turned on the computer is basically doing its own CONTROL-RESET and, since the buttons are down, it activates the self test. If you want to make the problem invisible and you have some cheapy paddles, you could open up the paddle box and and solder the switch closed.



Koala and most other Pads: These are great fun! Just turn them upside down or put a book on the buttons. To confound your victims, "assist" them by taking the book off during one of their tests ("There's nothing wrong with this computer!") and then putting it back on the buttons for the next.



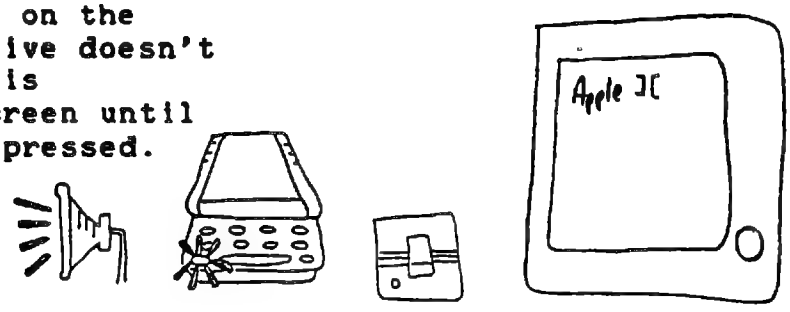
7. **Symptom:** All signs are go for a few seconds, then the disk drive growls, the computer beeps and an I/O error message or a * with some numbers (machine language) appears on the screen.



Reason: It is so easy to blame the computer, but this event is brought to you by a bad disk! To make this disk, do as described in chapter VII. Basically, the disk is initialized with a part of the disk operating system missing. The computer does fine until it gets lost in DOS.

For our workshop on repair and maintenance, we have a set of initialized test disks. Each one is assigned to a computer. Just before this debugging exercise I swap an identical looking bad disk with one of the good ones.

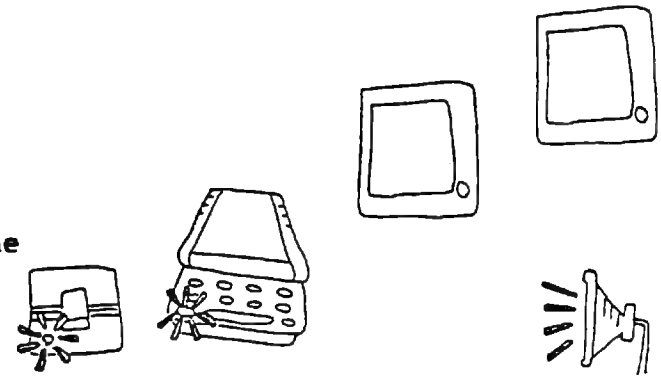
8. **Symptom:** The computer light comes on, beeps, and displays "Apple][" on the screen. The disk drive doesn't respond. No cursor is displayed on the screen until a control-reset is pressed.



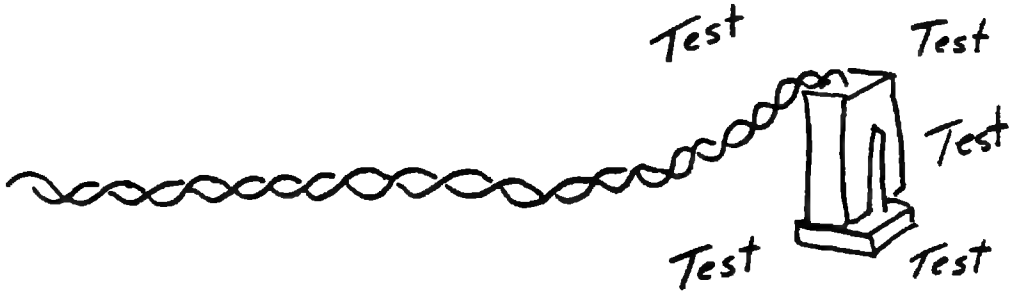
Reason: The disk drive is connected to the "DRIVE 2" connector on the disk interface card. The computer always looks at DRIVE 1 on the card for a disk drive. If none is there it just kicks up its feet and waits until it "sees" one. It could be a long wait!

This particular situation happens when equipment is moved around a great deal. Someone will set up a dual drive system and then the next period (school- right?) your fellow teacher takes one of the drives (Drive 1) and connects it to another system. Instant frown and worry affects the next user of that stripped computer.

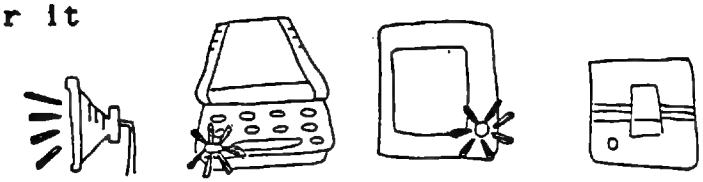
9. **Symptom:** When the computer is turned on the speaker beeps, makes weird sounds, the screen roles through a series of different displays, and the disk drive refuses to work. These are the same symptoms as no. 6 above.



Reason: The keyboard cable connection to the main board is loose. If the cable is loose, but is still making some contact the computer will usually go into a test pattern.

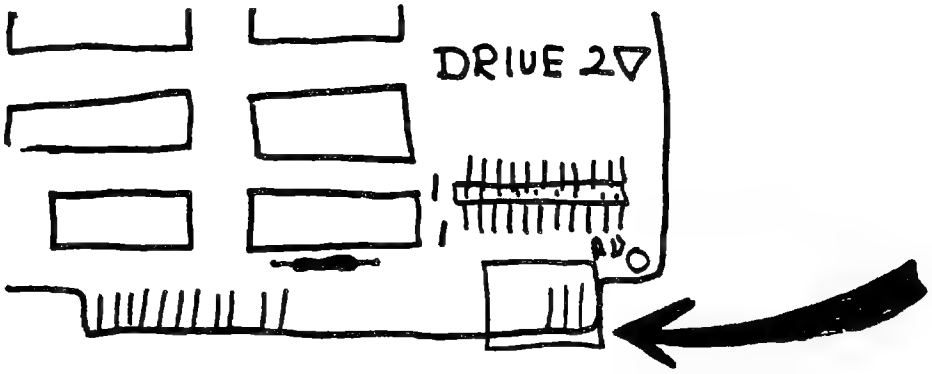


10. **Symptom:** The computer beeps, the keyboard light comes on, and the screen comes on properly. The disk drive either fails to come on or it does but doesn't boot the system.

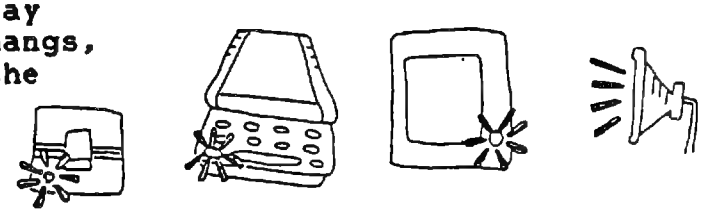


Reason: This is simulated corrosion on the disk interface card (i. e., tape over one or more of the contacts. The effect of the corrosion is to interrupt the communication between the computer and the disk drive. If you happen to tape the contact that supplies power to the disk drive then the lights are out tonight! If you happen to tape the ones that transfers information between the computer and the drive, then the computer spins but no information gets past the tape.

I use clear tape so it is harder to detect. Just remove the drive card and put the tape over some of the contacts. Reinsert the card into its slot.

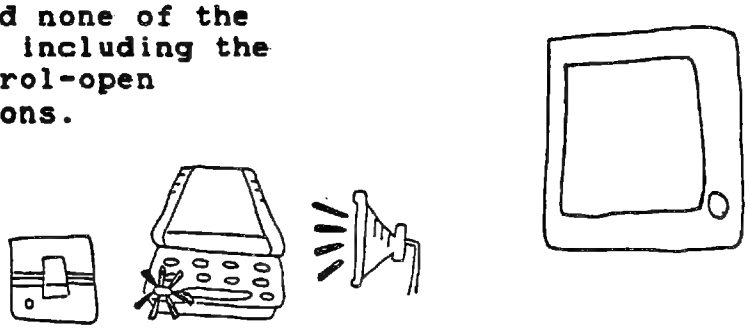


11. **Symptom:** The system boots up correctly, but when PR#3 is entered to turn on the 80 column display the computer either reboots, hangs, or doesn't respond at all to the command.

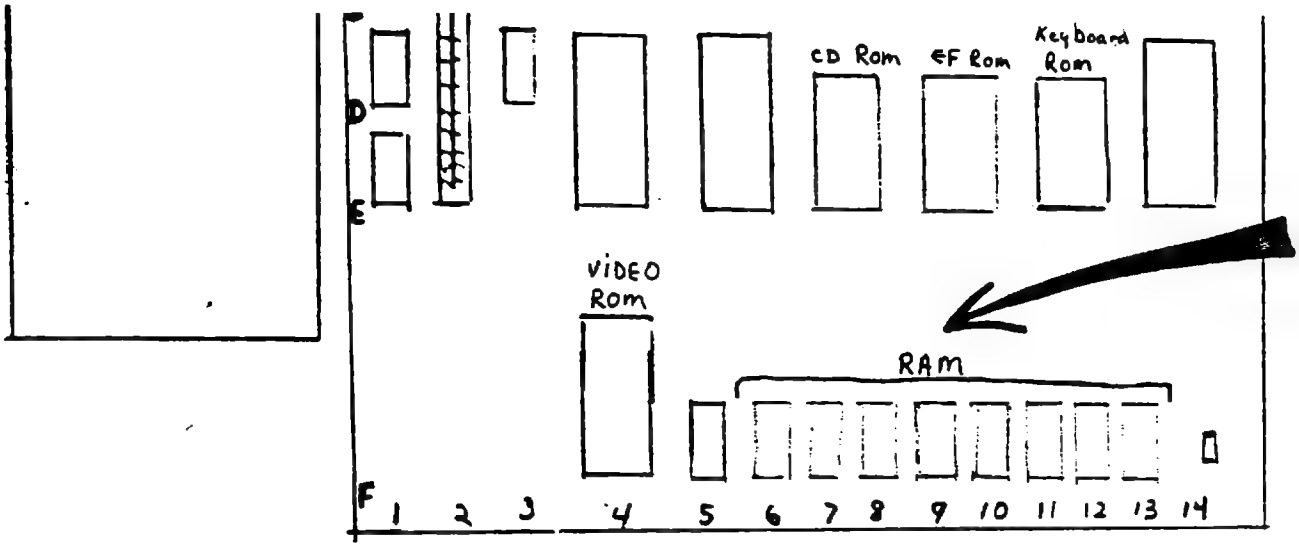


Reason: Another "instant rust" case! This time the 80 column or extended 80 column card is taped. Depending on what fingers are covered, the above results will occur.

12. **Symptom:** Random characters fill the screen when the computer is turned on. The disk drive usually won't work and none of the keys have any affect, including the control-reset or control-open apple-reset combinations.



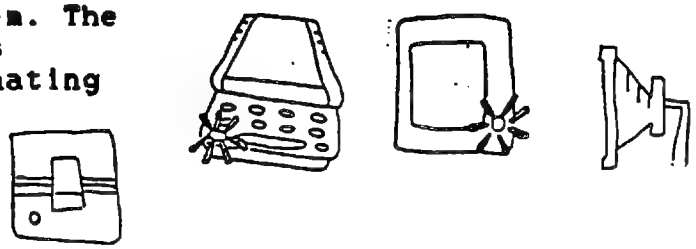
Reason: One of the RAM chips is loose, causing this total breakdown of the system. To simulate this disaster turn off the computer, ground yourself and extract one of the RAM chips (located at F6-F13 on the main board) using the extractor.



Then set the chip above the socket with at least one pin not making contact. Turn on the computer to see the response. If it functions properly, power down and loosen the chip a little more and test again.

Note for Apple II, II+ fans: The same test can be done on your computer but the RAM chip must be one in the first row. (Remember, the Apple II and II+ were able to function as 16K machines so only the first 8 chips are vital to its opening ceremony!)

13. **Symptom:** The computer light comes on, but no speaker sound and the disk drive is dead. None of the keys have any affect on the system. The screen <u>usually</u> displays vertical bars of alternating light and black.



Reason: The LS245 chip is not doing its part in the system. This main board chip located at B2 will cause this problem if it is damaged, or in this case loose. Read number 12 above for procedures for setting up this situation.

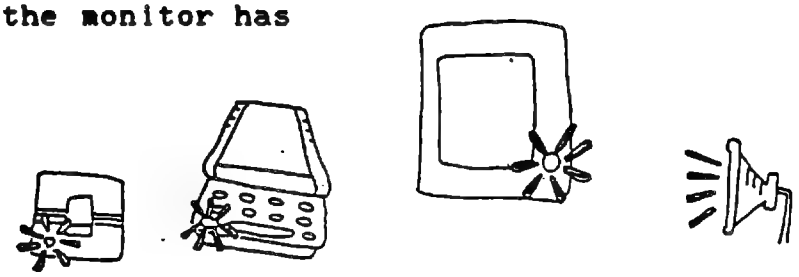
****

REDUCE TO A MODULE

****

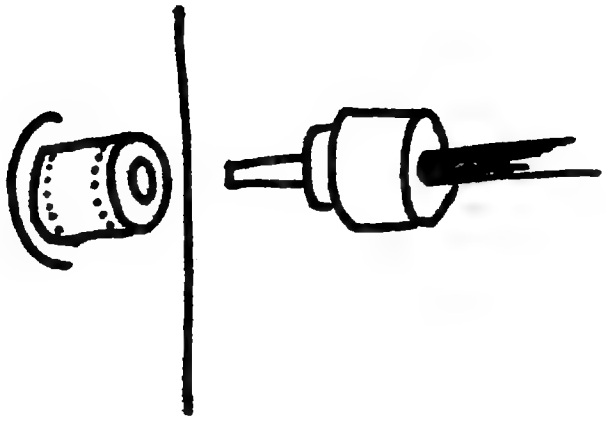
<u>Note</u>: Many of these problems would be caused by bad chips or other parts. Chips can be made "bad" for these exercises by carefully bending one of the pins out or just removing the chip completely.

1. **Symptom:** All looks normal except the monitor has no picture.



Reason: People first suspect a defective monitor and are ready to send it in for an expensive repair. The problem is the $2-$3 video cable from the computer to the monitor. We were lucky enough to find a bad one (it only took us about 30 minutes of frustration!). If you want to set up a

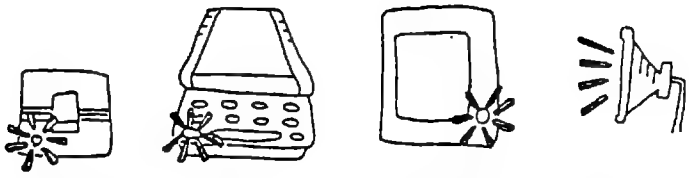
problem similar to this, tape the outside edge of the monitor jack with clear tape and then slip the video connector over the tape. This won't blank the screen but it will blur it.



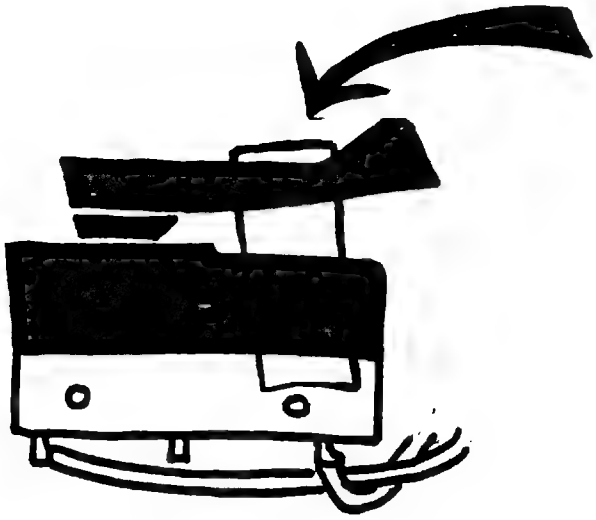
2. **Symptoms:** The system appears to be normal. The only problem that occurs is when a program is to be saved on the test disk. The message

WRITE PROTECTED

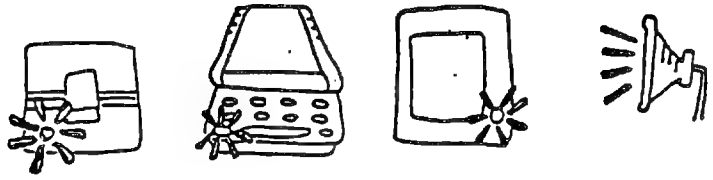
appears on the screen.



Reason: The write protect switch is malfunctioning. To simulate this problem, remove the drive cover and scotch tape the switch in the down position. In this mode the computer is unable to store information on the disk.

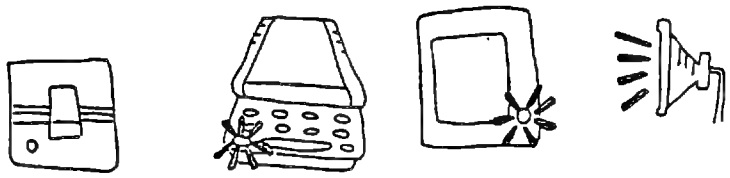


3. **Symptom**: Everything functions properly except the system never boots and the disk drive continues to spin without results.



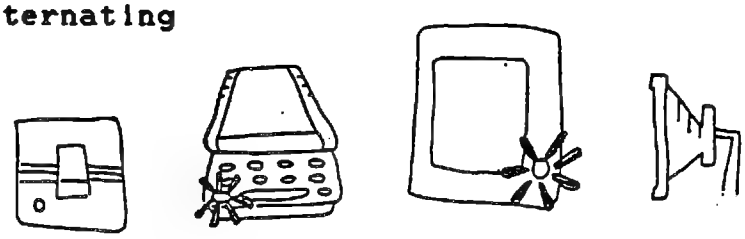
Reason: This a symptom of a blown LS125 chip on the disk drive. To set this up, remove the drive cover and extract the LS125 chip. This chip suffers the most in the Apple II system so it is a good one to test.

4. **Symptom**: The computer responds properly but the disk drive never boots.

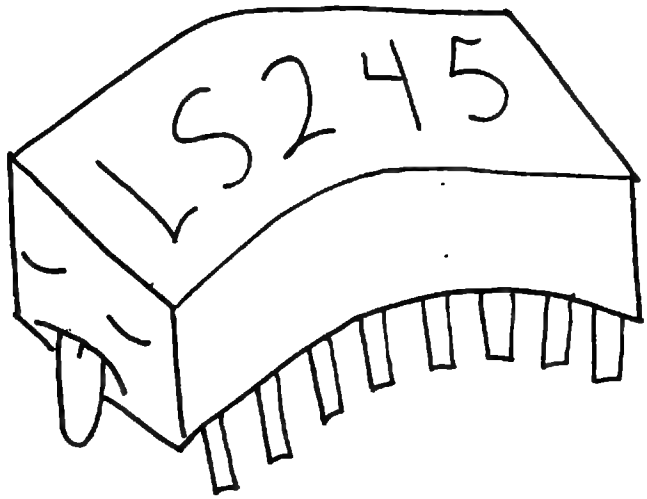


Reason: This is a bad 9334 chip (same as an LS259) on the disk interface card. If you bend a pin out, different symptoms will occur depending on your choice of pins.

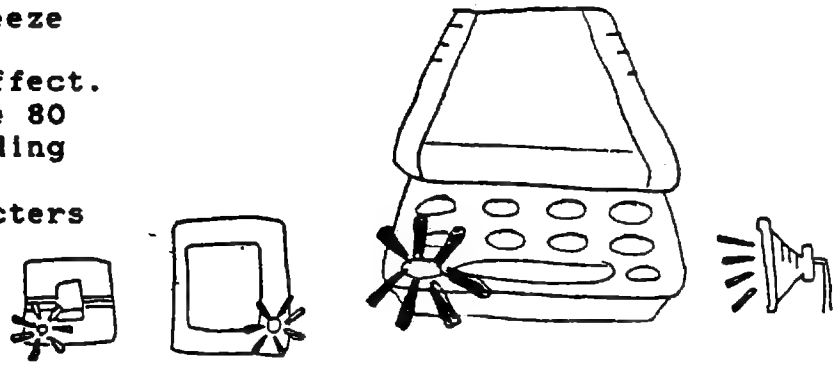
5. **Symptom**: The computer light comes on, but there is no speaker sound and the disk drive is dead. None of the keys have any affect on the system. The screen <u>usually</u> displays vertical bars of alternating light and black.



Reason: The LS245 at location B2 on the main board is bad. Again, pins can be bent out to simulate this problem. See number 12 under fixables for more information.

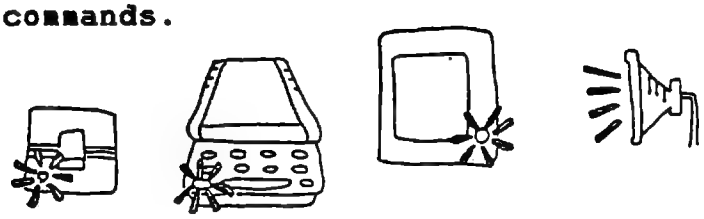


6. **Symptom:** One of the following will occur:
(a) The computer will freeze up.
(b) Typing PR#3 has no affect.
(c) PR#3 will turn on the 80 column screen but holding down the RETURN key produces random characters on the screen.



Reason: The LS245 chip on the (extended) 80 column card is defective. Different symptoms will occur depending on which pin you bend out or how a defective chip was blown.

7. **Symptoms:** The computer seems to function correctly but simple logic errors occur. Examples: In a spread sheet program "8" always occurs in any of the math operations. In BASIC programming the computer can't follow its commands.



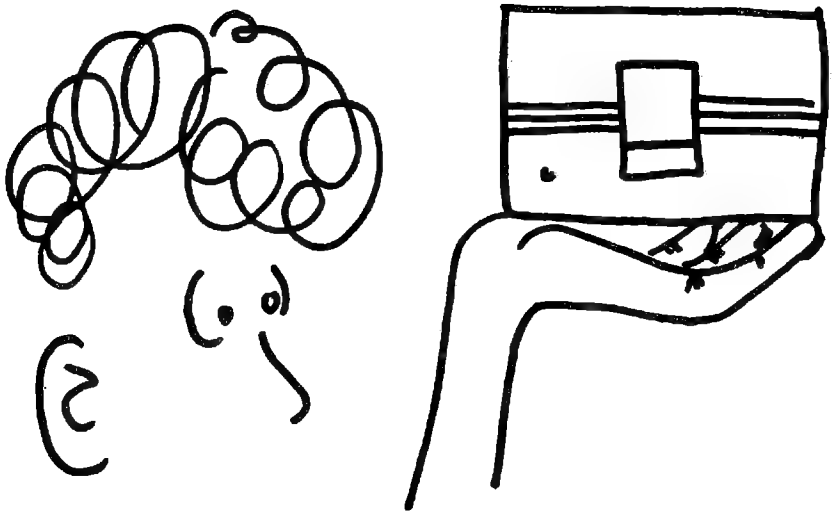
Reason: The computer's CPU chip or one of the ROMs is defective. If you want to bend a pin to simulate this symptom, be sure to handle the chip with care because most of these are Apple parts and must be purchased through your Apple service center.

Most of my other "reduce to module" exercises involve chips that have gone bad. If you are serious about training yourself or others, start collecting defective chips, record the symptoms they cause and ask others to help you. Sometimes electronics repair centers will let you have these parts.

During the repair class we have a few people who want to dirty their hands and try swapping chips. These folks are the ones we use to find all the bad test chips which were the root of evil in the bugged systems!

Be sure, as you do these test or train others, that everyone heeds the cautions on working with computer systems (chapter III). We have had hundreds of people go through training and we have damaged equipment only when these rules were not emphasized enough. One disk drive connected improperly can produce great defective chips for future class demonstrations but it would be easier and cheaper to bend pins!

The results of these exercises are phenomenal. We have had students (media specialists, high school students, first grade teachers, principals, etc.) who, in some cases, have never opened the lid of the Apple. After diagnosing and solving 30 problems we have to watch these confident students like a hawk or they will "accidentally" drop a disk drive or computer just so they can have another challenge!



Appendix: Computer Repair Pretest

Directions: Are you good enough to handle the Apple computer?? Of course you are! But here is a test to keep you in doubt. Take the test and then compare your answers with ours hidden in the book. If you found all the answers please send them to us so we will know what they are!!

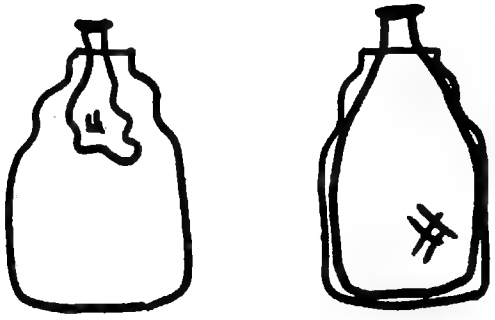
1. What is the small hole in the disk drive for???

2. How many motors are in the Apple disk drive?

3. When the disk is in the drive is information read and stored on the top or the bottom of the disk?

4. What chip is replaced most often in the Apple computer system?

5. Can you blow up a ballon in a jar? Use a small mouth jar (apple juice or milk jar) and a fairly large ballon. Hold the balloon at the neck of the balloon and blow it up until it fills most of the jar.



6. What does "DOS" stand for?

7. Describe in 500 words or less what SSDD, SSSD, DSSD, and DSDD mean in reference to disks.

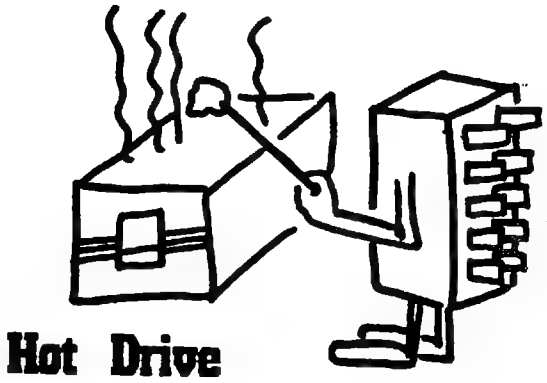
8. What equipment do you need to hook an Apple computer to a video recorder so that computer action can be saved on video cassette?

9. The smell of burning plastic means...

10. How do you turn on the second disk drive of a two drive system?

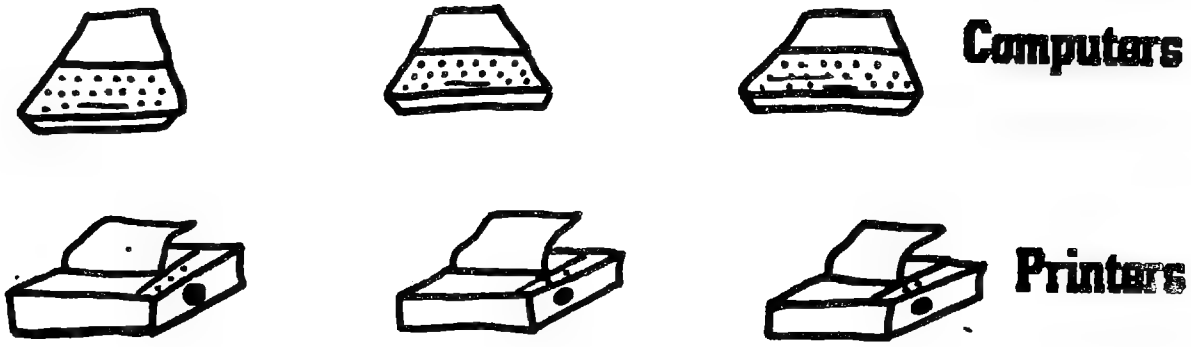
11. Give ten good reasons why you shouldn't use "generic" disks.

12. Describe what appears on the screen when all cards are removed from the computer and is turned on.



13. How do you unstick a disk in its jacket? The plastic won't turn because the jacket is squeezing it.

14. Here are some super printers and computers. Each computer can work with three printers and each printer can be connected to three computers. Connect printer cables from each computer to <u>each</u> printer. The printer cables must not cross each other or interference will occur.



15. Why the "PR" in PR#6??

16. Describe how to find a bad bulb(s) in a string of "all or none" Christmas tree lights. These are the type that if one light is bad the system won't work.

17. How can you re-boot an Apple IIe which is already on without shutting the computer off and turning it back on?

18. How many chips are on the Apple IIe motherboard?

19. Why do disk drives fail so much?

20. One of the most mispronounced words (top 10!) is "data". How should it be pronounced?

21. How do you unjamb a disk that is stuck inside a disk drive?

22. How many tracks are on the standard formatted disk? How many of these can you use?

23. After turning on the computer, what happens and why when you type <u>SAVE</u> and press return? Note that no file name is given.

24. Why do some disks, especially word processing data disks, when booted cause the computer to beep and display:

* A=9A X=56 Y=10 P=00 S=B7

TRY THESE FIRST

1. CHECK CORDS, CABLES.

2. CHECK FOR PROPER SLOTS AND CONNECTIONS.

3. RESEAT CABLES.

4. RESEAT SLOTTED CARDS.

5. RESEAT CHIPS.

6. CHECK THE DISK.

7. ADJUST THE MONITOR.

5 STEPS TO DIAGNOSE PROBLEMS

STEP 1: OBSERVE- DISPLAY, SOUND, LIGHTS.

STEP 2: REMOVE PARTS- LOOK FOR BAD MODULES.

STEP 3: SEPARATE PARTS- TEST CARD WITHOUT DEVICE.

STEP 4: TEST- CHECK MODULES IN A GOOD COMPUTER.

STEP 5: HELP!- CAN'T FIND PROBLEM.

INDEX . . .